

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE
OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION
FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JANUARY 22, 1904.

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GEOGRAPHY IN THE UNITED STATES.* I.

For twenty years past our section has acknowledged in its name an equal rank for geology and geography, but not one of the vice-presidential addresses during that period, or, indeed, since the foundation of the association over fifty years ago, has been concerned with the subject second named. Unless we cross off geography from the list of our responsibilities, it should certainly receive at least occasional attention; let me, therefore, depart from all precedents, and, even though geologists may form the majority in this gathering, consider the standing of geography among the sciences of the United States; how it has reached the place it now occupies, and what the prospects are for its further advance.

One measure of the place that geography occupies in this country may be made by considering the share that geographical problems have had in the proceedings of our association; here follow, therefore, the results of a brief examination of our fifty volumes of records. In the early years of the association there was no fixed division into sections. The meetings were sometimes so small that papers from various sciences were presented in general session. At least once in the early years the work of our predecessors was recorded under the general heading, 'natural history, etc.' As early as in 1851 there was a section of

* Address of the vice-president and chairman of Section E—Geology and Geography—of the American Association for the Advancement of Science, St. Louis meeting, December, 1903.

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

geology and physical geography, and another of ethnology and geography, but that classification did not endure. Once only, in 1853, did geography stand by itself as a sectional heading, but at many meetings physics of the globe and meteorology had places to themselves. Through the '60's and '70's geography was sometimes coupled with geology, but the latter more often stood alone or with paleontology, and it was not until the Montreal meeting of 1882 that Section E was definitely organized with the title that it now bears.

In those years when physics of the globe and meteorology were given sectional rank, problems concerning the ocean and the atmosphere received a good share of attention. It is curious to note, in contrast to this, how little consideration has been given to the exploration and description of the lands, that is, to the geography of the lands, in this Association for the Advancement of Science, either before or after the establishment of the double name for our section. The exploration of foreign lands, for many years a prominent subject in the meetings of the British Association, where geography has had a section to itself since 1869, has attracted hardly any notice in our gatherings; perhaps because we have been busy exploring our own domain. At the first meeting, 1848, a summary of then recent explorations, prepared by Alexander, is the only paper of its kind. Other papers treating the geography of foreign lands are so few in number that most of them may be noted here; in 1850, Squier gave an evening address on the volcanoes of Central America; in 1858 and 1860, Hayes and Wheildon discussed arctic exploration; Orton described the valley of the Amazon in 1869; in 1884 and 1898, two English visitors had papers on different parts of Asia; in 1891 and 1898, Crawford described features of Nicaragua; and

in 1894 and 1895, Hubbard read papers on China, Corea and Japan. Even geological essays on foreign regions have been few; Dana, Branner, Hill, Spencer, Heilprin and Hitchcock being the chief contributors. Inattention to foreign exploration is, however, not to be fully explained by devotion to the geography of our own country, so far as the latter is measured by the pages devoted to it in our proceedings. The first meeting started well enough, with accounts of the terraces of Lake Superior by Agassiz, of the physical geography of northern Mississippi by Bolton, and of the topography of Pennsylvania and Ohio by Roberts. Again, in 1851, when physical geography was named with geology, the first subject had two essays, the distribution of animals in California, and the climate, flora and fauna of northern Ohio; and geography joined in the same year with ethnology had three rather scattering titles: a deep-sea bank near the Gulf Stream, measurement of heights by the barometer, and a geographical department in the Library of Congress; but this beginning had no worthy sequel. The many expeditions across our western territory contributed little geographic matter to our records; in 1856 Blake described the orography of the western United States, and Emory the boundary of the United States and Mexico; and the latter added in 1857 an account of the western mountain systems of North America. From that time onward there has been very little primarily of a geographical nature concerning the United States. Even the modern discussions of glacial geology in the last twenty years, profitable as they have been to the physical geographers of glaciated regions, have in very few, if any, cases been presented as contributions to geography. The new phase of the physiography of the lands is scantily represented; there have been

hardly more than accounts of Mexico by Hill, of California by Perrin Smith, of North Carolina by Cobb; it is to be noted, moreover, that these three authors are primarily geologists, not geographers. This meager showing leads one to suspect that our proceedings do not give a fair measure of geographical activity in North America.

There has been in reality a great deal of work of a geographical nature done by our people, but the proceedings of the association do not seem to have commended themselves as a place to put the work on record. Our geological surveys, state and national, have contributed numerous geographic chapters and reports of prime value; our weather bureau is in many respects the leading institution of its kind; our coast survey sets a high standard for triangulation, coast maps and tide current studies; we have held a prominent place in arctic exploration, and have taken some part in exploration elsewhere. But in spite of all this accomplishment, we have not made great contributions to the full-fledged science of geography. There are, for example, few steps toward scientific geography of greater value than good maps, but for the geographer to stop with the production of good maps is as if the botanist stopped with the collection of dried plants. The survey reports of our various states and territories contain a great fund of geographical matter, and some of the members of these surveys have carried the physical geography of the lands so far forward as to develop it into a new science, to which a name, geomorphology or geomorphogeny, has been given; yet geography has not flourished among us as a maturely developed subject. The survey reports have not, as a rule, been prepared by persons whose training and interests were primarily geographical, and very few of the geomorphogenists have carried their new science forward into a geograph-

ical relation; they have usually stopped with the physical aspects of the subject, and left the organic aspects with scanty consideration. It is as if there had been some impediment in the way of the full development of geography as a maturely organized science. There are in fact three serious impediments.

During all these years geography has suffered greatly from being traditionally a school subject in its educational relations; the subject as a whole has been almost everywhere omitted from the later years of college and university training, although certain of its component parts have received some attention in college years. Again, geography as a whole leads to no professional career outside of school-teaching; it is perhaps chiefly on that account that our colleges and universities can give little time to it. Finally, there is not to-day in this country an organized body of mature geographical experts at all comparable to the bodies of physicists or of zoologists who are organized into effective working societies; in the absence of such an organization geography suffers greatly for the lack of that aid which comes from mutual encouragement among its workers. How can we remove these impediments of low educational rank, no professional career and no professional organization?

Geography will find a place in our colleges and universities very soon after it is shown to be a subject as worthy of such a place as are the subjects whose position is already assured. Physical geography is to-day slowly winning a more respected place than it has ever had among the subjects on which examinations are set for admission to college. Commercial or economic geography is, I believe, destined to attract increasing attention from mature teachers and nearly mature students. The general geography of various parts of the world must receive more and more consid-

eration in our colleges during the century that opens with the outgrowth of our home country; and just so soon as mature teachers of mature geography can make their lectures of value to the young men of to-day, who are to be the leaders of enterprise to-morrow, place will be found for geographical courses in our higher institutions of learning. Progress in this respect is visible, though not rapid. In order to hasten progress, increased attention might well be given to so-called practical courses in geography, as well as to courses of a generally descriptive nature. The impediment of low educational rank is not permanent; it need not discourage us, for it is destined to disappear.

The study of geography is not likely soon to lead to a large, independent career, but it may be made useful in many careers, as has just been indicated. It will, however, be made particularly serviceable to a class of men that is now of small but of increasing numbers, namely, those who travel about the world, seeking fortune, entertainment or novelty. With the present rapid increase of wealth among us, this class is destined to grow, and while it may never be large, it may soon be important, and its members need careful cultivation; and at the same time the teachers of this class, and of other classes with whom geography becomes important, will win a respected career for themselves. The impediment arising from the lack of a large professional career will, therefore, have no great importance when the many relations of geography to other subjects are recognized.

The third impediment to the maturing of geography is the most easily overcome even if at present the most serious, for its removal depends only on the action of geographers themselves, and not on the action of higher bodies, such as executive officers, trustees and so on, or on the action

of lower bodies, such as students. The absence of a society of mature geographical experts is the fault of the experts themselves. No greater assistance to the development of mature scientific geography lies within our reach than the establishment of a geographical society which shall take rank with the Geological Society of America, for example, as a society of experts, in which membership shall be open only to those whose interests are primarily geographical and whose capacity has been proved by published original work in a distinctly geographical field. In order to determine whether such a society can now be organized, I propose to consider the classes of persons in the community from which the members of the society could be recruited.

There are at least four classes of geographical associates, as they may be called, from which mature geographical experts might be drawn. First and in largest number is the class consisting of the teachers of geography in our schools. It is true that our school-teachers, as a rule, devote themselves to immature geography; that is, to only so much of the whole content of the subject as can be understood by minors, indeed by children. But, on the other hand, one who is acquainted with recent educational progress can not fail to recognize the notable advance made in the last ten years alone in the preparation for and in the performance of geographical teaching. There are in the secondary schools to-day a number of teachers who are competent to make original, mature geographical exploration of their home country, and some of them have actually traveled east and west with the object of making geographical studies. There are several teachers' geography clubs, and the leading members of these clubs are thoughtful workers. I am sure that a significant number of ac-

ceptable members of an expert geographical society would be found in this class.

The second class of geographical associates includes the observers of the national and state weather services, who have chiefly to do with that important branch of geography comprehended under climatology; these observers are gathering a great crop of facts, not always very accurately determined or very widely applied as far as the observers in the state services are concerned; yet from among the thousands of persons thus employed there will now and then come forth the original worker whose contribution will fully entitle him to expert rank; when his published studies are seen to be of a thoroughly geographical character and of a mature grade, they would warrant his admission to a society of geographical experts.

Third comes the class made up from the members of various governmental bureaus, state and national, whose work is of a more or less geographical character; for example, topographers and hydrographers, geologists and biologists, ethnologists and statisticians; this class being as a whole of much higher scientific standing than the two classes already mentioned. It may happen that many persons thus classified have a first interest in the strictly geographical side of their studies, although faithful work in the organization to which they belong associates them with other sciences. I should expect the greatest part of the membership in a society of geographical experts to be drawn from this class.

It may be noted that the absence of a body of mature geographers, as well organized and as scientifically productive as are the workers in various other sciences, is explained by some as an inherent characteristic of geography, necessitated by the great diversity of its methods and its interests. The diversity is already an embar-

rassment, it is claimed, even in school years; and it afterwards compels the separation of the branches of this highly composite subject, at best but loosely coherent, into a number of specialities, each of which is so much more closely allied to other sciences than to the other branches of geography, that those workers whose union would constitute a body of mature geographical experts are found scattered among other unions, geological, botanical, zoological, ethnological, economical and historical. The claim that the disunion of geographical experts is necessary does not seem to me well founded. May we not, indeed, prove that there is no such disunion by pointing to the fourth class of geographical associates, concerning whom my silence thus far may perhaps have awakened your curiosity, namely, the members of our various geographical societies?

There are at the present time between five and seven thousand such persons in the United States, but in the absence of any standard of geographical knowledge from the requirements for membership, these societies can not, I regret to say, be taken as evidence that there is a common bond by which experts in all branches of geography are held together. None of our geographical societies is composed solely of experts, and none of them is held together by purely geographical bonds. While we must not overlook the excellent work that our geographical societies have done, neither must we overlook the fact that in making no sufficient attempt to require geographical expertness as a condition for membership, there is a very important work that the societies have left undone. They have truly enough cultivated a general interest in subjects of a more or less geographical nature, but they have failed to develop geography as a mature science. Indeed, it may be cogently

maintained that the absence of any standard of geographical knowledge as a condition for society membership has worked as seriously against the development of mature scientific geography as has the general abandonment of geographical teaching to the secondary schools. Large membership seems to be essential to the maintenance of good libraries in handsome society buildings, and it is certainly helpful in the collection of funds with which journals may be published and with which exploring expeditions may be equipped and sent out. I should regret to see the membership in a single existing geographical society decreased, but I regret also that there is no geographical society of the same rank as the American Mathematical Society, the American Physical Society or many others in which number of members is secondary to expert quality of members. Large numbers of untrained persons are not found necessary to the maintenance of vigorous societies in which these other sciences are productively cultivated, and it is, therefore, reasonable to believe that large numbers would not be essential to the formation of a geographical society of high standing. Indeed, it can hardly be doubted that the acceptance of a low standard for membership in our geographical societies has had much to do with the prevailing indifference regarding the development of a high standard for the qualification of geographical experts.

Not only may any respectable person obtain membership in any of our geographical societies, however ignorant he may be of geography, but various kinds of societies are ranked as geographical, even though their object may be geographical in a very small degree. This is indicated by a list of geographical societies recently published, in which is included a small travelers' club lately organized in one corner of our country. The object of this

club is simply 'the encouragement of intelligent travel and exploration.' Interest in rather than accomplishment of exploration and travel suffice to recommend a candidate, otherwise qualified, for membership. The object of travel is nowhere stated to be geographical. As a matter of fact, travel for the sake of art, archeology, language, history, astronomy, geology and botany, for discovery, or even only for sport and adventure, as well as for strictly geographical objects, is encouraged by this young organization, which is really nothing more than its name claims it to be: a travelers' club. The same list of geographical societies includes several clubs of excursionists, outing-takers or mountain climbers, among whom, as a matter of fact, geography attracts hardly more interest than botany. These societies are doing an excellent work in taking their members outdoors, sometimes on walks near home, sometimes farther away to a hotel in the country, sometimes to a camp among the mountains. The chief result of such outings is an increased enjoyment and appreciation of the landscape, of natural scenery and of everything that enters into it; but this excellent result is by no means exclusively, perhaps not even largely, geographic in its quality.

One might question whether geographic rank was really accorded to these clubs by general assent, if their recognition in the group of geographical societies were expressed only by an individual opinion in the list referred to; but this is not the case. In preparation for the meeting of the International Geographical Congress, to be held in this country next summer, delegates to the committee of management have been invited from the Appalachian Mountain Club, in one corner of the country, and from the Mazamas in another. The delegates appointed by these clubs are, as might have been expected, men compe-

tent to act with the others in organizing the congress for us, but the same result would have been attained if delegates had been asked from the various geological, botanical, zoological and historical societies, for all these societies contain among their members persons of a certain amount of geographical knowledge and of a sufficient executive ability. The same would be true had delegates been invited from the Boone and Crocket Club, a choice organization of sportsmen, for all such clubs have men of undoubted ability in the way of organization among their members, and are largely concerned with matters of geographical location and distribution in their activities. Nevertheless, neither the sporting nor the outing clubs are essentially or characteristically geographical in their objects. Do not, however, understand me to object to the acceptance of delegates from the above-named clubs as members of the committee on management of the International Geographical Congress. I approve of the plan heartily; for in the absence of geographical societies in many parts of our country there was no other plan so appropriate. The matter is mentioned here only to show the straits to which geographers are reduced in attempting to give a national welcome to an international geographical congress; the difficulty, so far as it is a difficulty, arises from the absence among us of a body of mature geographical experts, united in an advanced acquaintance with some large part of a well-defined science. This condition of things seems to me unsatisfactory. The absence of a strong society of geographical experts indicates an insufficient attention to scientific geography, and I, therefore, now turn to consider the direction in which serious efforts may be most profitably made toward a better condition of things. Let it be understood, however, that no quick-acting remedy is possible, for the reason

that many of those concerned with the problem—namely, the advance of scientific geography—do not seem to recognize that the existing state of things needs a remedy. It is, therefore, only as a change of heart—a scientific change of the geographic heart—makes itself felt that much can be accomplished toward the development of scientific geography, and such a change is notoriously of slow accomplishment. Progress is apparent, however, and from progress we may gather encouragement. In what direction, then, shall our further efforts be turned?

Let me urge, in the first place, that close scrutiny should be given to things that are properly called geographical, with the object of determining the essential content of geographical science and of excluding from our responsibility everything that is not essentially geographic. Only in this way can we clear the ground for the cultivation of really geographical problems in geographical education and in geographical societies. This scrutiny should be exercised all along the line: in the preparation of text-books, in the training of teachers, in the study of experts, and in the conduct of any geographical society that attempts to take a really scientific position. The essential content of geographical science is so large that the successful cultivation of the whole of it demands all the energies of many experts. Those who are earnestly engaged in cultivating geography proper should treat non-geographic problems in the same way that a careful farmer would treat blades of grass in his cornfield: he would treat them as weeds and cut them out, for however useful grass is in its own place, its growth in the cornfield will weaken the growth of the corn. So in the field of geographical study, there is no room for both geography and history, geography and geology, geography and astronomy. Geography will never gain the

disciplinary quality that is so profitable in other subjects until it is as jealously guarded from the intrusion of irrelevant items as is physics or geometry or Latin. Indeed, the analogy of the blades of grass in the cornfield is hardly strong enough. It is well known that Ritter, the originator of the causal notion in geography, and, therefore, the greatest benefactor of geography in the nineteenth century, was so hospitable in his treatment of history that his pupils grew up in large number to be historians, and his own subject was in a way lost sight of by many of his students who became professors of geography, so-called, in the German universities, until Peschel revolted and turned attention again to the essential features of geography proper.

Close scrutiny of what is commonly called geography will certainly be beneficial in bringing forward the essence of the subject and in regulating irrelevant topics to the background; but it is not to be expected that any precise agreement will soon be reached as to what constitutes geography, strictly interpreted. Opinions on the subject, gathered from different parts of the country, even if gathered from persons entitled to speak with what is called 'authority,' would probably differ as widely as did the nomenclatures of the leading physiographic divisions of North America as proposed in a symposium a few years ago; but if careful consideration and free discussion are given to the subject, unity of opinion will in due time be approached as closely as is desirable.

As a contribution toward this collection of opinions, let me state my own view: the essential in geography is a relation between the elements of terrestrial environment and the items of organic response; this being only a modernized extension of Ritter's view. Everything that involves such a relationship is to that extent geographic.

Anything in which such a relationship is wanting is to that extent not geographic. The location of a manufacturing village at a point where a stream affords water-power is an example of the kind of relation that is meant, and if this example is accepted, then the reasonable principle of continuity will guide us to include under geography every other example in which the way that organic forms have of doing things is conditioned by their inorganic environment. The organic part of geography must not be limited to man, because the time is now past when man is studied altogether apart from the other forms of life on the earth. The colonies of ants on our western deserts, with their burrows, their hills, their roads and their threshing floors, exhibit responses to elements of environment found in soil and climate as clearly as a manufacturing village exhibits a response to water-power. The different coloration of the dorsal and ventral parts of fish is a response to the external illumination of our non-luminous earth. The word *arrive* is a persistent memorial of the importance long ago attached to a successful crossing of the shore line that separates sea and land. It is not significant whether the relation and the elements that enter into it are of easy or difficult understanding, nor whether they are what we call important or unimportant, familiar or unfamiliar. The essential quality of geography is that it involves relations of things organic and inorganic; and the entire content of geography would include all such relations. A large library would be required to hold a full statement of so broad a subject, but elementary text-books of geography may be made by selecting from the whole content such relations as are elementary, and serviceable handbooks may be made by selecting such relations as seem important from their frequency or their significance. The essen-

tial throughout would, however, still be a relation of earth and life, practically as Ritter phrased it when he took the important step of introducing the causal notion as a geographical principle.

Thus defined, geography has two chief divisions. Everything about the earth or any inorganic part of it, considered as an element of the environment by which the organic inhabitants are conditioned, belongs under physical geography or physiography.* Every item in which the organic inhabitants of the earth—plant, animal or man—show a response to the elements of environment, belongs under organic geography. Geography proper involves a consideration of relations in which the things that belong under its two divisions are involved.

The validity of these propositions may be illustrated by a concrete case. The location and growth of Memphis, Helena and Vicksburg are manifestly dependent on the places where the Mississippi River swings against the bluffs of the uplands on the east and west of its flood plain. The mere existence and location of the cities, stated independently of their controlling environment, are empirical items of the organic part of geography, and these items fail to become truly geographic as long as they are stated without reference to their cause. The mere course of the Mississippi, independent of the organic consequences which it controls, is an empirical element of the inorganic part of geography, but it fails to become truly geographic as long as it is treated alone. The two kinds of facts must be combined in order to gain the real geographic flavor. Geography is, therefore, not simply a description of places; it is not simply an account of the earth *and* of its inhabitants, each described independ-

* It should be noted that the British definition of physiography gives it a much wider meaning than is here indicated.

ent of the other; it involves a relation of some element of physical geography to some item of organic geography, and nothing from which this relation is absent possesses the essential quality of geographical discipline. The location of a cape or of a city is an elementary fact which may be built up with other facts into a relation of full geographic meaning; but taken alone, it has about the same rank in geography that spelling has in language. A map has about the same place in geography that a dictionary has in literature. The mean annual temperature of a given station, and the occurrence of a certain plant in a certain locality, are facts of kinds that must enter extensively into the relationships with which geography deals; but these facts, standing alone, are wanting in the essential quality of mature geographical science. Not only so; many facts of these kinds may, when treated in other relations, enter into other sciences; for it is not so much the thing that is studied as the relation in which it is studied that determines the science to which it belongs. I, therefore, emphasize again the broad general principle that mature scientific geography is essentially concerned with the relations among its inorganic and organic elements; among the elements of physical and of organic geography, or, as might be said more briefly, among the elements of physiography and of ——. Let me confess to the most indulgent part of this audience that I have invented a one-word name for the organic part of geography, and have found it useful in thinking and writing and teaching; but inasmuch as the ten, or at the outside twelve, new words that I have introduced as technical terms into the growing subject of physiography have given me with some geological critics the reputation of being reckless in regard to terminology, it will be the part of prudence not to mention the new name for

organic geography here, where my audience probably consists for the most part of geologists.

There can be no just complaint of narrowness in a science that has charge of all the relations among the elements of terrestrial environment and the items of organic response. Indeed, the criticism usually made upon the subject thus defined is, as has already been pointed out, that it is too broad, too vaguely limited and too much concerned with all sorts of things to have sufficient unity and coherence for a real science. Some persons, indeed, object that geography has no right to existence as a separate science; that it is chiefly a compound of parts of other sciences; but if it be defined as concerned with the relationships that have been just specified, these objections have little force. It is true, indeed, that the things with which geography must deal are dealt with in other sciences as well, but this is also the case with astronomy, physics, chemistry, geology, botany, zoology, history, economics. * * * There is no subject of study whose facts are independent of all other subjects; not only are the same things studied under different sciences, but every science employs some of the methods and results of other sciences. The individuality of a science depends not on its having to do with things that are cared for by no other science, or on its employing methods that are used in no other science, but on its studying these things and employing these methods in order to gain its own well-defined object. Chemistry, for example, is concerned with the study of material substances in relation to their constitution, but it constantly and most properly employs physical and mathematical methods in reaching its ends. Botanists and zoologists are much interested in the chemical composition and physical action of plants and animals, because the facts of composi-

tion and action enter so largely into the understanding of plants and animals considered as living beings. Overlappings of the kind thus indicated are common enough, and geography, as well as other sciences, exhibits them in abundance. It may be that geography has a greater amount of overlapping than any other science; but no valid objection to its content can be made on that ground; the maximum of overlapping must occur in one science or another—there can be no discredit to the science on that account. Geography has to do with rocks whose origin is studied in geology; with the currents of the atmosphere, whose processes exemplify general laws that are studied in physics; with plants and animals, whose forms and manner of growth are the first care of the botanist and zoologist; and with man, whose actions recorded in order of time occupy the historian; but the particular point of view from which the geographer studies all these things makes them as much his own property as they are the property of any one else.

In view of what has been said, let me return to the close scrutiny that I have urged as to what should be admitted within the walls of a geographical society. We will suppose the geography of Pennsylvania is under discussion; as a result there must be some mention of the occurrence of coal, because coal, now an element of inorganic environment, exerts a control over the distribution and the industries of the population of Pennsylvania. But the coal of Pennsylvania might be treated with equal appropriateness by a geologist, if its origin, its deformation and its erosion were considered as local elements in the history of the earth; by a chemist, if its composition were the first object of attention; by a botanist, if the ancient plants that produced the now inorganic coal-beds were studied. Furthermore, it

would be eminently proper for the geologist to make some mention of the present uses to which coal is put; or for the chemist and the botanist to tell something of the geological date when coal was formed, if by so doing the attention of the hearer could be better gained and held, and if the problem at issue could thereby be made clearer and more serviceable. So the geographer is warranted in touching upon the composition, the origin, the exploitation of the Pennsylvania coal-beds, if by so doing he makes a more forcible presentation of his own problem; but if he weakens the presentation of his own problem by the introduction of these unessential facts, still more if he presents these unessential facts as his prime interest, he goes too far. The point of all this is that students in many different sciences may have to consider in common certain aspects of the problems presented by the coal of Pennsylvania; but that each student should consider Pennsylvania coal in the way that best serves his own subject. The scrutiny that I have urged would, therefore, be directed chiefly to excluding from consideration under geography the non-geographic relations of the many things that various sciences have to study in common, and to bringing forward in geography all the problems that are involved in the relations of the earth and its inhabitants. The things involved in the relations of earth and life are the common property of many sciences, but the relations belong essentially to geography. It would be easy to point out topics in text-books and treatises, in the pages of geographical journals and in lectures before geographical societies, that would not fall under any division of geography as here defined. In many such cases, however, the topics might without difficulty have been given a sufficiently geographical turn, had it been so desired or intended; the topics might have been pre-

sented from the geographical point of view, so as to emphasize the essential quality of geographical study, had there been a conscious wish to this end. But in other cases, the subjects presented belong so clearly elsewhere, or are treated so completely from some other than a geographical point of view, as to fall quite outside of geography; for example, a recent number of one of our geographical journals contained an excellent full-page plate and a half page of text on the 'Skull of the Imperial Mammoth,' with brief description of its size and anatomy, but with nothing more nearly approaching geographical treatment than the statement that the specimen came from 'the sands of western Texas.' In all such cases it is open to question whether close scrutiny as to inclusion and exclusion has been given, and while the policy pursued by many geographical societies of generously accepting for their journals many sorts of interesting articles has something to commend it in the way of pleasing a mixed constituency, it is, nevertheless, open to the objection of not sufficiently advancing the more scientific aspects of geography. Blades of grass and mammoth skulls are very good things, if crops of hay and collections of fossils are to be gathered; but they are in the way of the growth of the best corn and of the publication of the best geographical journals. Let no one suppose, however, that the audiences in geographical lecture halls or the readers of geographical journals need suffer under the scrutiny that is here urged regarding lectures and articles. There is, even under the strictest scrutiny, an abundance of varied and interesting matter of a strictly geographical nature; few, if any, sciences are richer than geography in matter of general interest. There is, indeed, some reason for thinking that the real obstacle in the way of applying close scrutiny in the way here recom-

mended is the difficulty of obtaining high-grade material presented in an essentially geographical form. Inasmuch as this difficulty arises from the relative inattention to geography as a mature science, it is the business of geographical societies to remove the difficulty.

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(To be concluded.)

SOME UNSOLVED PROBLEMS OF ORGANIC ADAPTATION.*

WITH the advent of the 'Origin of Species' became current the naturalistic interpretation of organic nature, epitomized in such phrases as 'natural selection,' 'survival of the fittest,' etc. So rapid and general was the acceptance of this conception as a working hypothesis that in thirty years, or within a single generation, Wallace made bold to claim for it universal recognition in the well known and oft-quoted declaration, 'He (Darwin) did his work so well that descent with modification is now universally accepted as the order of nature in the organic world.'

As a general statement of the fact of evolution, as the phrase may be literally interpreted, it may, after fifteen additional years of intense biological activity, be as vigorously claimed and as readily conceded. If, however, it be so interpreted as to include the full content of Darwinism and the all-sufficiency of natural selection as the prime factor, with its details of endless adaptations to environment, whether physical or physiological, it need hardly be said that consent would be far less general or prompt.

Moreover, with the highly metaphysical and speculative deductions which, under the caption of 'Neo-Darwinism,' or, more plainly, 'Weismannism,' which have

boldly assumed the omnipotence and all-sufficiency of natural selection to account for the least and last detail of organic differentiation or constancy, widespread doubt and open protest are too common to elicit surprise or comment.

It need hardly be pointed out at this late day, though it is more or less persistently ignored, that primitive Darwinism, while essaying to explain the origin of *species*, and emphasizing the importance of natural selection as a means in the process, did not in the least presume to account for the origin of *variation* and *adaptation*, which were recognized as fundamental and prerequisite in affording conditions without which natural selection must be hopelessly impotent. Nor, moreover, should it be overlooked that while recognizing the inseparable correlation of the factors just mentioned and their essential utility either to the individual or species in the majority of cases, Darwin was free to concede and frank in declaring the efficiency of many other factors in the intricate and complicated problems of organic evolution.

The recent impulse which has come to biologic progress by experimental methods, and the remarkable results which have been attained thereby, may without exaggeration be said to have raised anew many an earlier doubt as well as brought to light problems apparently beyond the scope of the older explanations. It may not, therefore, be an extravagant assumption to announce the entire question of organic adaptations as open for reconsideration, in the light of which no apology will be necessary for directing attention to certain phases of the subject upon the present occasion.

Among the many problems which recent investigations and conclusions have brought into better perspective as well as sharper definition, and which might profitably be discussed, the limits of a single address preclude any very wide range of

* Address of the vice-president and chairman of Section F, Zoology, St. Louis meeting, 1903.

review. I have, therefore, chosen to restrict my discussion chiefly to problems of coloration among lower invertebrates, including incidental references to correlated subjects, and the probable limitations of color as a factor in organic adaptation.

Interesting as it might be to glance at the earlier views of a subject, the nature of which from earliest times must have been a source of keen interest to mankind in general, and which must have appealed to the esthetic and rational nature, inspiring not only poetic imagery, but admiring awe and a devout fervor akin to reverence, it must suffice in the present discussion to hold attention well within the period of thought immediately concerned, which, as already indicated in the opening paragraph, was brought into prominence by the 'Origin of Species.'

As is perfectly well known, color in nature is due to one of two causes, or to a combination of both, namely: (1) What has been termed optical or structural conditions, such as diffraction, interference or unequal reflection of light, examples of which are familiar in the splendid hues of the rainbow, the iridescent sheen and metallic colors of the feathers of many birds, wings of insects, etc. (2) What are known as pigmentary colors, due to certain material substances lodged within the tissues of animals or plants which have the property of absorbing certain elements of light and of reflecting others, and thereby producing the sensation of color. While the two are physically quite distinct it is not unusual to find them associated in producing some of the most exquisite color effects of which we have knowledge. In a general way one may usually distinguish between these two sorts of color by noting that those which are purely optical in their character produce a constantly changing impression as the relative position of object or observer may happen to vary with

reference to the angle and direction of light; while, upon the other hand, colors which are due to pigments show this property very slightly or not at all, and that, moreover, pigment colors are usually more or less soluble in various reagents, such as alcohol, ether, acids, alkalies, etc., and that they often fade rapidly under the influence of strong light or in its absence, or upon the death of the organism.

The presence of many and various colors in inorganic nature, the large majority of which are due to purely physical causes, such as the colors of the ocean, the sky, the clouds, the mineral or gem, while appealing to our sense of beauty elicit no special inquiry as to their significance or purpose. It suffices to know that they are constitutional or structural, inseparable from the physical conditions in which they have their place.

It is different, however, with much of the color found in the organic world. While such colors as those of the grass or leaf might seem to have hardly any different significance or to call for special explanation different from the preceding, as Wallace has pointed out, on the other hand, as he has also forcefully expressed it: "It is the wonderful individuality of the colors of animals and plants that attracts our attention—the fact that colors are localized in definite patterns, sometimes in accordance with structural characters, sometimes altogether independent of them; while often differing in most striking and fantastic manner in allied species. We are, therefore, compelled to look upon color not merely as a physical but also as a biological characteristic, which has been differentiated and specialized by natural selection, and must, therefore, find its explanation in the principle of adaptation or utility."

It is under the stimulus of this conception that the significance of color has come

to have the large place and concern in the literature of evolution which it at present occupies, as expressive of which such well-known phrases as 'protective coloration,' 'warning colors,' 'mimicry,' etc., have come to be household commonplaces among us. It is not surprising, therefore, that in a book like Wallace's 'Darwinism' out of a total of some 475 pages more than 150 should be devoted to this phase of the problem alone, while it has frequent reference in other connections.

And the same is largely true of much of the literature dealing with the subject of organic colors. In other words, color in these relations has been studied largely, if not wholly, as a factor in adaptation—fitting the animal better to meet the exigencies of life in the struggle for existence, in certain cases serving as a disguise or screen against detection, in others by glaringly advertising some noxious quality, in still others by flying a signal of alarm or warning, and in flight serving to segregate the members of a herd in whose collective aggregate a larger measure of protection might be realized.

Hence it naturally came to pass that color was looked upon largely as a physical factor in the sum total of the animal's morphology which must have some fundamental relation to the adaptation or fitness for survival of the species. It is not strange, under prevailing conditions, that small attention was directed to the more fundamental problem of the *physiological* significance of color, or the part it has to do in the processes of metabolism of the individual organism. Recent work in experimental morphology has directed attention to this phase of the problem, and one of the objects of the present discussion will be to make somewhat more evident a too long neglected aspect of animal biology.

It ought not to be overlooked in this connection that along with the development in

experimental morphology to which reference has been made, those of organic chemistry, and particularly chemical physiology, have been perhaps equally important in directing attention to certain phases of our problem. Nor ought we to forget that the spectroscope has thrown its light upon the same general problem, though with perhaps less of conclusiveness than could have been desired. As a result of this growing activity there has been accumulated a body of information, a part of which stands directly related to the subject under consideration, and a part indirectly concerned with the same essential principles, and from it we may safely predict the solution of problems hitherto only predicated hypothetically, and such sidelights upon others equally important that it is not too much confidently to forecast substantial progress all along the line.

It may be well in this connection to glance briefly at some of the results at present known as in some measure justifying these somewhat optimistic assumptions, as well as pointing the line along which important and promising researches may be prosecuted.

The work of Krukenburg, MacMun, Macallum, M'Kendric, Hopkins, Urech, Eising, Cunningham and a host of others, comprising a mass of literature of enormous proportions, will be available to those interested and may afford some faint conception of the magnitude and importance of the field to be explored, as well as an introduction to that already made available. And while as a result of this activity many and various organic pigments have been isolated and their composition in part or entirely made known, it must be recognized that the task of the chemical analysis of any such highly complex compounds as most of these are known to be is attended with extreme difficulty and no small measure of uncertainty. Still, it

has been possible fairly to distinguish several classes of such pigments, differentiated physiologically as follows:

1. Those directly serviceable in the vital processes of the organism. Under this head may be classed such pigments as hæmoglobin, chlorophyll, zoonerythrin, chlorocrutorin and perhaps others less known. It need not be emphasized that by far the most important of these are the two first named. The others, found chiefly among the lower invertebrates, are believed to serve a function similar to the first.

2. Waste products. Among these the several biliary products are too well known to call for special note. Guanin is a pigment of common occurrence in the skin of certain fishes and is associated with the coloration of the species. Similarly certain coloring matters have been found in the pigments of many lepidoptera, known as lepidotic acid, a substance closely allied to uric acid and undoubtedly of the nature of a waste product.

3. Reserve products. Of these there are several series, one of which, known as lipochrome pigments, is associated with the metabolism involved in the formation of fats and oils. Perhaps of similar character are such pigments as carmine, or rather cochineal, melanin, etc. It may be somewhat doubtful whether these pigments do not rather belong to the previous class, where should probably be listed such products as hæmatoxylin, indigo, etc., all of which have been claimed as resultants of destructive metabolism in process of being eliminated from the physiologically active tissues of the body of the organism. Of similar character is probably tannic acid, a substance well known among plant products and involved in the formation of many of the brownish and rusty colors of autumn foliage, particularly of the oaks and allied trees, as are the lipochromes in the formation of the reds and yellows

which form so conspicuous a feature among autumn colors.

While the association of these and other pigmentary matters has long been known in connection with both animal and plant growth, and while the conception of their more or less intimate relation to the active metabolism of the various tissues is not new, comparatively little has been done toward directly investigating and elucidating the exact nature and extent of the process. This seems to be especially the case in relation to the part played by these products in the formation of those features of coloration among organisms with which we are now concerned.

The most strenuous advocates of the primary importance of natural selection as the chief or only factor in adaptation are free to admit that among the simplest forms particularly, color has originated in some more or less obscure way through growth or some of the vital activities of the organism, Darwin, for example, merely suggesting that 'Their brightest tints result from the chemical nature or minute structure of their tissues,' and Wallace in the even less explicit statement that 'color is a normal product of organization,' whatever that may imply.

So far as I am aware Eisig was among the earliest to claim that among certain annelids the colors were primarily expressions of the katabolic processes of the tissues, and were excretory in character. He was able largely to demonstrate this with species of Capitellidæ by experimental methods. By feeding the animals with carmine he was able to follow its course through the alimentary tract, its progress through the tissues, and final deposition in the hypodermal tissues beneath the cuticle, where in the process of moulting it was finally eliminated. He also found that in a species of *Eunice*, which fed upon sponges, the pigment granules of the food

passed unchanged through the intestine and into the body tissues much as had been the case in the experiments with the preceding.

Graff later reached very similar conclusions concerning coloration in the leeches, but was able to go a step farther than Eisig had done and to show in great detail the exact process through which it was brought about. He found in the endothelium certain migratory cells which wander about in the coelom or penetrate through the tissues, and that among their functions one of the most important seems to be the absorption of foreign bodies and their conveyance into the mouths of the nephridia or through the tissues to the hypodermis and their lodgment in that tissue. He was even able to show that the special markings or color patterns which are so characteristic of the animals may be explained by the disposition of the muscle bands, and their relation to the lines of pigmentary deposition by the wandering cells, which Graff has designated 'exeretophores.' He was also able to confirm the results of Eisig as to the experimental demonstration of feeding with various pigmentary matters, and subsequently tracing them from point to point in the process of elimination. Furthermore, he showed that the amount and density of pigmentation was closely related to the intensity of metabolism, being greatest in those specimens which were most voracious feeders.

Observations of a similar character have been made upon certain of the protozoa, particularly upon *Stentor*. Schuberg in 1890 found that the blue-green pigment so characteristic of this organism was constantly being excreted bodily in the form of definite granules.

In 1893 Johnson, in an extended study of the morphology of these protozoa, confirmed the preceding observations, and showed that the pigment was excreted

along with other excrementitious matter. He found also that the principal region of excretory activity was at the base of the animal, where was formed after a short time a definite mass of debris near the foot.

Perhaps one of the most important contributions along this line is that of Harmer on the character of the 'brown body' of the polyzoa. By a series of critical observations upon the life-history of these interesting organisms and painstaking experiments in feeding with carmine and other pigments, he was able to prove beyond reasonable doubt that the so-called 'brown body' of the polyzoa is a direct product of the destructive metabolism within the body and its excretion in a mass at this particular region. He found that the leucocytes of the funicular organ as well as certain cells of the organ itself engulfed pigmentary wastes, and with the periodic decline of the polypides these cells became crowded into a close mass, thereby constituting the 'brown body.' The new polypide arising by a sort of regenerative process was found to be always devoid of any coloration, no pigment appearing for some time following the activity of the new polypide, but that it is formed in regularly increasing amounts with the age and degree of metabolism of the organisms.

Correlated with these views concerning the origin of certain colors and their disposition in the organism is that of the relation of coloration to the food. It has long been known that in many cases there is a more or less intimate relation of color to the food consumed by certain animals. Instances of this are too numerous for detailed consideration here. Let it suffice that Darwin, Semper, Eimer, Koch, Beddard, Poulton, Gunther and many others have, by extended observations and by detailed experimentation, apparently established the general fact. Beddard quotes the following observation made by G.

Brown-Goodé as to such an explanation of protective coloration in fishes. "On certain ledges along the coast of New England are rocks covered by dense growths of scarlet and crimson seaweeds. The codfish, the cunner, the sea raven, the rock eel, and the wrymouth, which inhabit these brilliant groves, are all colored to match their surroundings; the cod, which has naturally the lighter color, being most brilliant in its scarlet hues, while others whose skins have a large and original supply of black have deeper tints or dark red and brown." He then quotes farther the suggestions of Goodé that these colors are due to pigment derived either directly or indirectly from the red algæ; those which are carnivorous feeding upon the crustacea and other marine organisms whose stomachs are full of the algæ and their pigments which pass unchanged into the tissues of the fishes.

He also quotes a similar conclusion of Gunther as to the origin of the red pigment of the salmon being derived from the red pigment of the crustacea upon which it feeds. While admitting that in the cases just cited there has been no attempt at demonstration of the proposed explanation, it yet would seem highly probable. "It is too remarkable a coincidence that the fish normally with but little pigment should when among these weeds be *bright red*, and that the fish normally possessing black pigment should be *dark red*, to permit of a settlement of the question off-hand by the easy help of natural selection—without at least some further inquiry."

With the foregoing considerations concerning the general origin and development of pigments and their relations to the colors of organisms, we may next proceed to pass rapidly in review such groups of animals as we may choose to consider, and may institute a brief inquiry as to the significance of their types of coloration as factors of adaptation.

With the avowed purpose of restricting my observations and discussion as far as practicable to the lower groups of invertebrates as already announced, it will suffice to say further that in justification of such a course I am constrained to consider the lower animals, particularly coelenterates, as more favorable subjects from which to obtain fundamental conclusions than are the more highly specialized insects or birds which have had so large a measure of attention in earlier investigations along these lines.

Furthermore, it seems highly probable that future investigations will involve more of direct experimentation than has hitherto been the case, and if so, these lower series will naturally afford some of the best material available for such inquiries, not only because of the more ready and rapid responses obtained, but from the relative simplicity of their organization and the consequent simplicity of results likely to be obtained in each case.

If further warrant were demanded for a comparatively limited survey, or special emphasis upon a limited group of animals, I should find it in a measure in the personal interest and familiarity which has come from special researches connected therewith.

Beginning with the hydrozoa it may be noted in the outset that though including the simplest of the Coelenterates we shall find a remarkable variety and range of coloration. Among the hydroids, as is well known, coloration is neither very remarkable as to brilliance nor distribution. Many, if not most, are almost without color distinction, except in the dull brownish or amber colors found in such as *Obelia*, *Halecium*, and other campanularians. This may be due in part to the fact that the colonies are so generally encased within a chitinous perisarc which, while somewhat colored as already indicated, is

seldom if ever of any considerable brilliance or diversity. Among the tubularians, in many of which the development of a perisarc is slight, and always lacking over the hydranth itself, there is often found considerable coloration, as in *Eudendrium*, *Pennaria*, *Corymorpha* and others. And in these color is usually found associated more particularly with the development of the sexual products, or during the season of reproductive activity, which is a matter of considerable significance, to be taken up in a later connection.

As is well known, the predominance of alternation of generations in these animals brings into prominence the sexual phase, which in most species is an independent organism—the medusa. And it is in connection with the medusæ that we find the most marked development of color. There does not, however, appear to be any well-defined distribution of colors into patterns. Among the Hydromedusæ the distribution of pigment, which is almost the only conspicuous kind of color present, is chiefly in association with the gonads, the tissues of the stomach and the regions of the chymiferous canals, though in some cases also extending to the tentacles and in the regions of the sensory organs. It should not be overlooked, however, that in many of these medusæ the color tints are among the most beautiful and delicate known, though lacking the intensity more common among the Scyphomedusæ and corals.

Turning attention to the Scyphomedusæ we find as just suggested a more copious development of color, and also what is more significant, in many cases its distribution into something like definite patterns, as is more or less evident in such genera as *Cyanea*, *Pelagia* and *Rhizostoma*. It is, however, no less evident that among these we have, as in the former, the deposition of pigment along the lines of most

active metabolism, such as the gastrovascular and reproductive organs, in most abundance and usually of greatest brilliance.

It is, however, when we come to the Anthozoa, which includes the corals, actinians, sea-fans, etc., that we find the climax of coloration, both as regards brilliance and intensity. To look into the crystalline depths of the waters about a coral reef where these varied forms thrive in great garden-like areas is to gaze upon a scene, the fairy-like features of which it would be difficult to exaggerate. Here are actinians, corals, sea-fans, sea-feathers, etc., which abound in the richest profusion and endless variety, seeming to vie with each other in the effort to produce the most exquisite displays of every tint of the spectrum.

In the distribution of color there is not apparently any advance as to differentiation over that found in the Scyphomedusæ, if indeed as much, though among the actinians certain stripings and mottlings occur over the exterior of the body. It is worthy of note that in those forms in which the tendency toward definite coloration is more evident there appears to be in many cases considerable variation of coloration. This is particularly noticeable in such forms as *Metridium* and *Cyanea*.

Face to face with this rich profusion and beauty of color what is its significance? How has it originated and what does it mean? Is it simply the expression of some original constitution peculiar to the entire class, and if so why does it differ in so marked a degree among the different subclasses? We may safely dismiss such an alternative as altogether unnecessary and without value as an explanation. May it be considered as an adaptation to protection, the result of natural selection? Certainly in no direct sense, for without exception, so far as I am aware, the more

brightly colored forms are thereby rendered correspondingly more conspicuous and, therefore, more liable to attack from enemies. May it come within the category of 'warning' coloration, due to the offensive cnidarian armor borne by most of the members of this phylum? So not a few who have essayed an account of the matter would have us believe. It seems to me, however, open to serious doubt, aside from the fact that it lacks evidence. On the other hand, among hydroids I have found that those having brighter colors are most liable to be eaten by fishes in the habit of feeding upon such a diet. Furthermore, various worms, snails, etc., which are known to feed upon them would be more likely to be attracted by colors than to be repelled. It is also matter of common observation that such animals are much more abundant among colonies of highly colored hydroids like *Eudendrium*, *Pennaria* and *Tubularia* than among species of *Obelia* or others of little color distinction. Many fishes with finely adapted dental apparatus are constant feeders upon corals, tranquilly browsing among the animated foliage of this luxuriant forest.

Finally, may it come within the category of 'sexual selection'? So far as I am aware, no one has ventured to assign to it any such a significance. Where sex characters are so little differentiated as among at least a portion of the phylum such an explanation would be as far-fetched as it would be unnecessary. While upon the part of some of the older naturalists there was a disposition to regard the massing of members of the Scyphomedusæ at certain times as having a sexual meaning, it may be doubted whether it has any considerable support in facts.

Concerning coloration among the anthozoa, Duerden, whose work on the group is so extended and so favorably known, has summarized the following account:

"The prevalence of the yellow and brown color is easily understood when an examination is made of the polypal tissues. For in all instances in which it occurs, the entoderm is found to be crowded with the so-called 'yellow cells' or Zooxanthellæ, which are unicellular, symbiotic algæ, the chromatophores of which are yellow or yellowish-green. That these are the main cause of the external coloration may be easily proved from colonies of *Madrepora*. In this genus the polyps toward the apex of branches are nearly colorless, and on a microscopic examination of the entodermal layer Zooxanthellæ are found to be absent while they are present in abundance in older pigmented regions."

These symbiotic algæ are not, however, the only source of color among the corals. Duerden finds ectodermal pigment granules, aggregated in somewhat irregular, isolated patches in some cases, in others somewhat regularly distributed.

He also found that a third source of coloration among corals was the presence of what he has termed 'boring algæ.' These were both red and green, and penetrate into the skeletal mass and color it a distinct red or green, as one or the other may be present.

In his work on the Actiniaria of Jamaica, this author has found in many cases the presence of unicellular green algæ growing upon the surface and giving to the polyp a distinctively green color. He found also superficial granular pigments in certain species which could be removed by any erosion of the ectoderm. I have found the same in several species of New England actinians, and in some cases the pigmentation was irregularly distributed, sometimes in blotches, sometimes in longitudinal stripes, more often the latter. So extremely variable is the coloration in many of these organisms that it is impossible to utilize it as a factor in differentiating spe-

cies. Duerden has called attention to this feature among both corals and actinians, and believes it to be due to the presence or absence of greater or less intensity of light, and believes it to be an expression of the fact that the Zooxanthellæ are not able to thrive except under proper light, and that, moreover, where light is too intense, as in shallower waters, certain dark pigment found in such specimens is thought to be due to its utility as a screen. While there may be a measure of credibility as to phases of this view, it does not seem to me as of general adequacy. The variability of species to which I have just referred and to the very common genus *Metridium* is certainly not due in any appreciable degree to the factor of light, since it occurs indiscriminately among specimens taken in identical situations as well as under those of differing conditions.

In this connection may be mentioned the same phenomenon among medusæ. The variation of coloration in *Cyanea* has long been known and is so marked that the elder Agassiz distinguished two additional species chiefly on this character, both of which have long since been discarded. It is quite well known to observers that these animals when placed in aquaria usually show within a very short time a more or less marked diminution in colors. *Dactylometra*, while living fairly well for many days in the aquarium, loses within this time so much of its usually bright coloration as not to seem like the same creature. The same is true of many other animals than medusæ. On the other hand, it is equally well known that many other animals may be placed under these more or less artificial environments with little apparent loss in this or other respect. That it is not due to light alone is evident in the fact that similar changes occur in medusæ which have been kept in open pools or enclosures about docks or elsewhere.

It seems to me rather that the true explanation is to be found in the changed conditions of nutrition and the consequent change in the metabolism of the animal. Hydroids placed under these conditions show the same tendency.

Those which take kindly to the change show no appreciable decline as to color or other vital process. The same is true of medusæ. *Gonionemus* may be kept for weeks in the aquarium, and if properly fed will show no decline in color, while if the conditions become bad an immediate change is noticeable in this as well as other features.

The same may be said concerning the actinians. While many seem to suffer noticeably when placed in aquaria others show no apparent difference. *Cerianthus membranaceus*, one of the finest of the actinians to be seen in the Naples aquarium, and one of the most variable, shows no apparent decline in any vital function. Specimens have been kept in flourishing condition in the aquarium for several years and show no sign of decline, the coloration continuing as brilliant as in the open sea. The same is true of many other organisms found in finest condition in this celebrated aquarium. Among the annelids *Protula* soon shows decline in color vigor, and the same is true, though to a less degree, in the case of *Spirographis* and *Serpula*.

While it may not be without probability that some measure of this color change may be due in certain cases to the changed conditions of light, it still remains true, I believe, that light alone is but a single factor, and that often a minor one involved in the changes observed, and that changed conditions of nutrition and metabolism are by far the more important.

The main factor of our problem, however, is still unsolved. What answer shall we make to ourselves concerning the sig-

nificance of the multiform colors more or less general among members of the coelentera? It seems to me more or less evident that natural selection can have at best but a limited place in its explanation. I see no place for it along the lines of protection, either direct or indirect.

Of even less significance can any modification of it under the guise of sexual selection be claimed; for even aside from the large majority of cases where there is slight if any sex differentiation, no sensory organization, which Darwin recognized as essential to the exercise of this factor, is present through which it might become operative in even the smallest degree.

Two, and only two, other methods of explanation have seemed to me to afford a reasonable account. First, that it is due primarily to the normal course of metabolism, during which color appears as one of its many expressions. Darwin himself was not indifferent to this possibility, and expressly states in connection with the same problem that color might very naturally arise under such conditions. "Bearing in mind," he suggests, "how many substances closely analogous to organic compounds have been recently formed by chemists, and which exhibit the most splendid colors, it would have been a strange fact if substances similarly colored had not often originated, independently of any useful end thus gained, in the complex laboratory of the living organism." It has also been pointed out in an earlier portion of this paper that Wallace had to appeal to a similar source in his search for the primary factors of animal coloration.

Geddes and Thomson in discussing the problems of sex likewise make a similar claim. They declare, "pigments of richness and variety in related series, point to

preeminent activity of chemical processes in the animals which possess them. Technically expressed, abundant pigments are expressions of intense metabolism." They further find in the phenomena of bright colors among the males of most of the higher animals simply the expression of the correspondingly greater activities of the process of metabolism.

I believe that in this source we have a real account of a considerable body of color phenomena among the lower invertebrates, and particularly of that series under present consideration.

The second factor to which I would appeal is so nearly related to the former as to be involved more or less intimately therewith. It is to the effect that certain pigments are products of waste in process of elimination. This has already been referred to in a former connection and need not be separately emphasized apart from the concrete cases to which it may be applied.

Strongly significant of the importance of this process among the Hydrozoa is the fact already pointed out that pigments are found deposited along the lines of principal metabolism, namely, the gastrovascular regions, the gonads, and to a less extent the immediate regions of sensory bodies, when these may be present. While this alone as a mere statement of fact does not prove the point at issue, when taken in connection with other facts of a similar nature, it amounts to a high degree of probability.

What evidence have we that in the case of hydroids, medusæ, etc., colors are associated with excretory processes? While the facts are not numerous, they are, I believe, rather convincing. In work upon regeneration in hydroids, Driesch and Loeb called attention to certain pigmentary matters found in *Tubularia* and

claimed for it an important function in the regenerative process. Morgan, and later Stevens, working upon the same hydroid, became convinced that the claims of the former investigators as to the importance of this pigment were not well founded. They found that not only was the pigment of no special importance, but that it was *really* a waste product, and that during the process of regeneration was actually excreted and finally ejected bodily from the hydranth. I have personally been able to confirm these results on the same and related hydroids, and have also shown that in regenerating medusæ there is formed *de novo* in each regenerating organ, such as manubrium, radial canals, etc., the characteristic pigment of the normal organ. This was particularly noticeable in the case of radial canals. Following their regeneration and promptly upon their functional activity the deposition of pigment made its appearance, and within a comparatively short time had acquired the normal intensity. This was also true of other organs, tentacles and tentacular bulbs, as well as manubrium and canals.

Substantially the same results have been obtained, though here first announced, in experiments upon one of the Scyphomedusæ. In very young specimens where the tissues are delicate it is possible to note the intense activity in regenerating organs, such as the sensory body. The first part of this organ to make its appearance is the sensory papilla, which is soon followed by the otoliths, and later by the special pigmentation of the entire organ.

From the foregoing considerations three things seem to me to be more or less evident:

1. That in all regenerative processes a very marked degree of metabolism is involved, whether in the mere metamorphosis

of old tissues into new, or in the direct regeneration of new tissues by growth processes, both of which seem to occur.

2. That in regenerative processes there is often associated the development of pigmentary substances which seem to have no direct function in relation thereto.

3. That in many cases there follows a more or less active excretion and elimination of portions of the pigment in question.

Concerning color phenomena among the several classes of worms we are in much the same uncertain state of mind as in the former. For while in some of the annelids there may be found fairly well developed visual organs it may be seriously questioned whether they are of any such degree of perfection as would enable their possessors to distinguish small color distinctions. And if this be the case there would at once be eliminated any possibility of conscious adaptation in seeking a suitable environment, or such as would be involved in so-called sexual selection.

Furthermore, it is very well known that among this group some which exhibit among the richest of these color phenomena have their habitat in seclusion, buried in sand or mud, or hidden beneath stones, or with tubes built up from their own secretions, or otherwise so environed as to render practically nil the operation of natural selection.

Again, it should not be overlooked in this connection that in many of the annelids, as well as others, the most pronounced source of color is to be found in the hæmoglobin dissolved in the blood, and that it would be as futile to ascribe its color to natural selection as it would to claim a similar explanation of the color of the same substance in the blood of vertebrates, where, *as color*, it is absolutely of no selective value; except in such special cases as the colors of the cock's comb, where it may

come to play a secondary function as a sex character.

What shall be said of such forms as *Bipalium* and *Geoplana* among land planarians, which exhibit in many cases brilliant coloration, but since they are chiefly nocturnal in their habit and conceal themselves during the day under logs or other cover, the color could hardly serve any selective or adaptive function?

The same is equally true of such forms as nemerteans whose habitat is beneath the sand along the tide line or below, and also of many annelids having a similar habitat. Some of these, particularly among the latter, have types of coloration which are often of brilliant character and splendid patterns, vying, as one writer has expressed it, 'with the very butterflies.'

It can not be questioned that in some cases we find among these forms what would seem at first sight to be splendid illustrations of protective coloration. If, however, we trace in detail their distribution and variable habitat we shall often find, as did Semper in the case of *Myxicola*, that the supposed case of marvelous mimicry resolves itself into merest coincidence. This case cited by Semper is described in detail in 'Animal Life,' and its careful study by some of our over-optimistic selectionists would prove a healthy exercise, conducing to a more critical scientific spirit and, as a consequence, to saner interpretations of appearances in the light of all the facts.

The mimicry in the case was of coral polyps among which the annelid was found growing and which, in the form of its branches, their size and coloration, seemed so perfect that it had long escaped notice and was described by Semper as a new species.

It was found in various localities among the corals, but invariably having precisely the same simulation of the polyps, so that

Semper noted it as among the finest cases of mimicry which had come to his attention. It so happened, however, that soon after he happened to discover his mimetic *Myxicola* growing upon a sponge whose color and form were so different as to render it very conspicuous. A systematic search for it in other situations soon revealed it among the rocks, and in his own language, 'Almost everywhere, and wherever I examined it carefully, it was exactly of the size and color of the polyps of *Cladocora caespitosa*.'

Attention has already been called to Eisig's account of coloration among the Capitellidæ, in which he discards the factor of natural selection as wholly inadequate in the case of the organisms under consideration as well as in many others, and refers to many investigators who have likewise found it deficient. In his exhaustive monograph the subject is discussed in considerable detail and references given which it would be impracticable to cite in such a review as the present.

It will be possible to refer but briefly to another group or two in the present discussion, the first of which is the echinoderms, and chiefly the starfishes. As is well known, these organisms exhibit a considerable range of variety and richness of coloration, among which red, orange, brown, yellow and black are more or less common. In not a few cases of course the colors comprise combinations of two or more of those named. An examination has been made of these pigments in a few cases and has sufficed to show that for the most part they are lipochromes and, therefore, belong to either reserve or waste products. Similar colors are also found among the brittle-stars, with occasional admixtures of blue or green, colors less common in the former group.

As is also well known similar colors are found among the crustacea, into a consid-

eration of which it is impossible to enter here. There is a matter, however, which I can not ignore in connection with the group, namely, the rather remarkable fact that in two phyla having so little in common as to habit, structure or environment, there should be so striking a color resemblance. This is further heightened by the fact that while one is a prey to almost every denizen of the sea of predatory habit, the other is almost correspondingly exempt. So far as I know echinoderms have few enemies, and are of course largely invulnerable against such as might otherwise find palatable feeding among these sluggish herds. If the color is in the one case protective, why not in the other? Or if it be not protective on the other hand, why claim such in the first? That sexual selection might have some place among crustacea may not seem improbable. But if color is its signal here what does it imply among echinoderms, where in the nature of the case it must be ruled out of account?

Discussing the significance of colors among the echinoderms Mosely submits the following interesting problem: "Those coloring matters which, like those at present under consideration, absorb certain isolated areas of the visible spectrum, must be considered as more complex, as *pigments*, than those which merely absorb more or less of the ends of the spectrum. * * * It seems improbable that the eyes of other animals are more perfect as spectroscopes than our own, and hence we are at a loss for an explanation on grounds of direct benefit to the species of the existence of the peculiar complex pigments in it. That the majority of species of *Antedon* should have vivid coloring matters of a simple character, and that few or only one should be dyed by a very complex one, is a remarkable fact, and it seems only possible to say in regard to such facts that the

formation of the particular pigment in the animal is accidental, *i. e.*, no more to be explained than such facts as that sulphate of copper is blue."

Considered from the standpoint of metabolism such facts would hardly seem to assume the difficulty which might be implied in the case just cited, indeed they are in perfect alignment with what might be anticipated, and what has in cases previously cited been found to be actually occurring.

Similar conditions as to color and color significance are also matters of common knowledge in relation to mollusca. Perhaps few groups among animals exhibit more brilliant and varied colors than are to be found among gasteropods, yet in many of them this factor can have no more value as a means of adaptation than do biliary pigments or hæmoglobin among vertebrates, where as pigments their significance is nil. Of them, Darwin, with his usual frankness, has said, as previously cited, "These colors do not appear to be of any use as a protection; they are probably the direct result, as in the lowest classes, of the nature of the tissues—the patterns and the sculpture of the shell depending on its manner of growth." Referring in the same connection to the bright and varied colors of nudibranchs, he further declares, "many brightly colored, white, or otherwise conspicuous species, do not seek concealment; whilst again some equally conspicuous species, as well as other dull colored kinds, live under stones and in dark recesses. So that with these nudibranch molluscs, color apparently does not stand in any close relation to the nature of the place which they inhabit."

Into the classic shades afforded by the insects as a fruitful haunt and stronghold of natural selection I must not venture. Not that its problems have all been solved,

nor that some considered as settled beyond controversy may not have to be readjusted, not excepting the much exploited *Kalima* itself, but out of pure regard for the exigencies of the occasion.

No more dare I presume to enter the abysses of the deep sea and to pass in review its manifold and almost untouched problems of color significance, great as is the temptation and attractive as are its inducements. It must suffice to suggest that had half the ingenuity which has been exercised to bring these problems into alignment with the general sway and supposed supremacy of natural selection been employed in an analysis of the pigments and some efforts to discover the origin of coloration and its general significance as a physiological, rather than as a physical one, we should have been saved the sad rites attending the obsequies of still-born hypotheses and half-developed theories. The desperate attempt to save natural selection from drowning in its submarine adventures by lighting its abyssal path with the flickering and fitful shimmer of phosphorescence was worthy of a better cause. It is difficult to be serious with this phase of a subject the nature of which demands anything but ridicule or satire. But the attempts to illuminate the quiescent abysses with the dull glow which under all known conditions requires, if not violent, at least vigorous stimulus to excite it, and the assumption that its sources were sufficient to meet even a moiety of the necessities involved, makes a draft upon one's credulity which might arouse either indignation or the sense of the ludicrous, depending upon the point of view! But seriously, such a conception apparently loses sight of too many evident known conditions of phosphorescence with which we are familiar, not to mention the growing belief that the phenomenon is in itself of the nature of one of the wastes of metab-

olism to justify the herculean attempt to make it serve a cause so desperate.

As a concluding word allow me to say that in the present review I have not in the least sought to ignore or discredit the value of natural selection as a factor in organic evolution. Nor would I be understood as wholly discarding color as a factor in organic adaptation, particularly among the higher and more specialized forms, but rather to show its limits. At the same time I must submit to a growing conviction that its importance has been largely overestimated, and that other factors have been as largely lost sight of. If the present discussion may serve in even the smallest degree to direct attention to some of the latter it will have served its chief purpose.

CHARLES W. HARGITT.

SYRACUSE UNIVERSITY.

SCIENTIFIC BOOKS.

THE HONEYSUCKLES.*

THIS notable addition to the literature of the genus *Lonicera* is a most welcome contribution, presenting as it does the first complete systematic treatment of the honeysuckles since their description by De Candolle in the fourth volume of his 'Prodromus,' published in 1830. Mr. Rehder has consulted the specimens preserved in all the larger American herbaria, and in the most important of those of Europe, and has consulted the living collections in the larger botanical gardens, his investigations having extended through several years. The treatment of the genus in De Candolle's 'Prodromus' recognized 53 species, of which 42 are now held to be valid; the present monograph recognizes 154 species, together with 3 imperfectly known and not named, making 157 in all, thus adding 115 species to those known in 1830. In addition to these 157 species, a large number of varieties are given rank, as also are a considerable number of forms recognized under name;

* 'Synopsis of the Genus *Lonicera*,' by Alfred Rehder (*Ann. Rep. Mo. Bot. Gard.*, 14: 27-232, pl. 1-20, October 8, 1903).

some of these varieties and forms will probably come to be taken as species or subspecies, but most of them are clearly only deviations from ordinary states of the species in color or size of various organs, and the formal recognition of such things lumps up nomenclature without any useful result.

Mr. Rehder recognizes two subgenera, *Chamæcerasus*, with four sections, and *Periclymenum*, following the division accepted by Linnæus, who united the four genera accepted by Tournefort in 1700, *Caprifolium*, *Periclymenum*, *Xylosteum* and *Chamæcerasus*, into the one genus *Lonicera*, of which it would appear that the *Lonicera Caprifolium* is to be taken as the type. Mr. Rehder remarks that the two subgenera form two very well-defined and natural groups if based on the character of the inflorescence, but he evidently does not agree to recent propositions to recognize them as genera. The genus *Distegia* of Rafinesque is only given rank as a subsection, while *Nintooa* of De Candolle is given rank as a section. Including the Mexican types, 21 North American species are recognized, no new ones being described by Mr. Rehder from within this territory in the present work; of recently described North American species, *L. sororia* of Professor Piper is reduced to *L. conjugialis* Kellogg and *L. ebractulata* of Dr. Rydberg is found to be inseparable from *L. Utahensis* S. Watson. The species which has long been called *L. ciliata* Muhl., is found to have an older name in *L. Canadensis* Marsh.; *L. villosa* Michx. is reduced to a variety of *L. cærulea* L., following Torrey and Gray; *L. flavescens* Dippel is made a variety of *L. involucrata* (Richards) Banks; *L. Japonica* Thunb., naturalized in recent years in eastern North America from New York southward, is not uncommonly cultivated in the West Indies; *L. sempervirens* receives a new variety in var. *hirsutula* Rehder from North Carolina, but an examination of two of the specimens cited leads me to believe that this has no serious claim to recognition under name; *L. subspicata* H. and A. and *L. interrupta* Benth., reduced to varieties of *L. hispidula* by Dr. Gray, are restored by Mr. Rehder to specific rank; *L. dumosa* Gray, which has

recently been regarded as synonymous with *L. albiflora* T. & G., is maintained as a variety of that species; Dr. Rydberg's recently proposed *L. glaucescens* is accorded specific rank. Only one American species known to the writer is not referred to by Mr. Rehder, being described by Dr. Small in his 'Flora of the Southeastern United States,' issued in July, 1903, viz., *Lonicera flavescens* from Tennessee and Kentucky; in naming this species, which is related to *L. Sullivantii* and to *L. flava*, Dr. Small inadvertently overlooked the older *L. flavescens* of Dippel, so that if the species holds good it will have to receive another name.

Mr. Rehder's excellent paper is illustrated by four plates of details of inflorescence and morphology and by reproduced photographs of little-known or rare Asiatic species taken from sheets in the older herbaria of Europe, largely from the collections at St. Petersburg.

Mr. Rehder records 14 doubtful species at the end of his monograph which he has been unable to refer satisfactorily, and 24 hybrids, most of which have originated in various gardens, where the parent species have been growing in proximity; none of the hybrids is indicated as of origin in the wild condition; two fossil species of the genus are known, both of them from European terranes.

N. L. BRITTON.

International Catalogue of Scientific Literature. First annual issue. O, Human Anatomy. London, Harrison & Sons. 1903 (June). Pp. xiv + 212. Price, ten shillings and sixpence.

Although the plan of this catalogue is excellent and its contents are good as far as they go, it is improbable that any anatomist who has access to Schwalbe's 'Jahresberichte ueber Anatomie und Entwicklungsgeschichte' will find it very useful. For several generations past anatomists have been accustomed to excellent year-books and a new catalogue will naturally be compared to those already in existence. The last volume of Schwalbe (1901) is a large book containing over 1,300 pages, filled with numerous abstracts, giving the titles to over 3,300 papers taken from over

650 journals. To be sure, all the papers on anatomical subjects which appeared in 1901 are not given in this volume, and there are numerous papers appearing in 1900 catalogued, but the series of volumes gives practically a complete catalogue of such papers.

When we compare the new catalogue with Schwalbe's so many deficiencies are at once seen that only a few of them can be mentioned in this review. Less than half as many titles (about 1,600) are given as in Schwalbe. To be sure, it is stated in the preface of the new catalogue that it is to be a *complete* index, but it is noted that the literature of Austria has not been included and this omission of literature is not sufficient to account for the difference between the new catalogue and Schwalbe's. The omissions are best expressed by making some comparisons. In Schwalbe's 'Jahresbericht' the blood and lymph, the female organs of sex and the integument are represented by 301, 65 and 74 titles and in the new catalogue by 77, 43 and 36 titles respectively. Under 'Pedagogy and Biography' we miss, among others, Spalteholz, 'Zum 70 Geburtstag von Wilhelm His'; Gegenbaur, 'Erlebtes und Erstrebtes'; Barker, 'On the Study of Anatomy,' and Jackson, 'A Method of Teaching Relational Anatomy'; all of which are given in Schwalbe's 'Jahresbericht.' We also do not find any reference to the *Journal of Morphology*, *The Biological Bulletin*, *The Journal of Experimental Medicine*, *The American Journal of Physiology*, *The Johns Hopkins Hospital Reports*, *The Bulletin of the Johns Hopkins Hospital*, *The American Journal of Anatomy*, *The Journal of Comparative Neurology*, the *Proceedings of the Association of American Anatomists* and the *Journal of Medical Research*, each of which contains articles on anatomy—83 altogether. In the new catalogue we find but one reference to Minot and one to Bardeen; in Schwalbe there are eleven references to these two authors.

While there are many omissions there are also many duplications. Spalteholz's 'Atlas' with its translation is entered thirteen times; Szymonowicz, which came out in parts is given fifteen times, while Stöhr is given six times in the subject catalogue and not at all in the

authors' catalogue. There are also a number of contributions which should not have been included in this catalogue, *e. g.*, Meisenheimer, 'Die Entwicklung von Herz, Perikard, Niere und Genitalzellen bei *Cyclas*,' etc., and also a few subjects catalogued under the wrong headings. Eisler on the 'Muscularis Sternalis' should be under 'Abnormalities' and Parskij, 'Die Anatomie und Histologie der Schilddrüse,' should not be under 'Pituitary Body.'

The above illustrations are only a few, but they are sufficient to show that the 'International Catalogue of Scientific Literature on Human Anatomy' is very incomplete; so much so, that anatomists will not find in it a substitute nor a supplement to the lists accompanying the *Anatomischer Anzeiger* nor to Schwalbe's 'Jahresbericht.' It is to be hoped that the volume for 1902 will include all the titles found in any of the lists, for they are at hand and can be copied and supplemented. A *complete* authors' catalogue with a subject catalogue will be welcomed by all anatomists.

M.

SCIENTIFIC JOURNALS AND ARTICLES.

WE have received the first number of the *Journal of Philosophy, Psychology and Scientific Methods*, edited by Professor Frederick J. E. Woodbridge, of Columbia University and published by The Science Press (Sub-station 84, New York City). The contents are as follows: 'The International Congress of Arts and Science,' Professor Hugo Münsterberg; 'The Religious Consciousness as Ontological,' Professor George Trumbull Ladd; 'Some Points in Minor Logic,' Christine Ladd Franklin; 'The Third Meeting of the American Philosophical Association'; 'Stratton's Experimental Psychology,' Professor H. Austin Aikens; 'Journals and New Books'; 'Notes.' The scope of the journal is explained in an editorial note which reads: "In so far as an explanation or even an excuse may be needed for the establishment of a new journal, it is hoped that this may be given by the contents and form of the first number of *The Journal of Philosophy, Psychology and Scientific Methods*. There are in

Germany 'Centralblätter' for nearly all the sciences, and there are in all countries 'trade journals' for the applied sciences such as medicine and engineering. But there exists no journal covering the whole field of scientific philosophy, psychology, ethics and logic, appearing at frequent intervals and appealing directly to the interests of all professional students. It is a matter of importance at the present time that the relations between philosophy and psychology should remain intimate, and that the fundamental methods and concepts of the special sciences, now receiving attention on all sides, should be kept in touch with philosophy in its historic development. What may be accomplished by the prompt publication of short contributions is demonstrated by the *Comptes Rendus* of the Paris Academy, whose four-page articles cover nearly the whole scientific activity of France. A fortnightly journal is particularly suited for discussion, the interval being just long enough to permit of questions and answers. Finally the special function of such a journal is the quick and complete publication of reviews and abstracts of the literature."

The Botanical Gazette for December contains the following articles: E. N. Transeau, in a paper 'On the Geographic Distribution and Ecological Relation of the Bog Plant Societies of Northern North America,' finds that the bog plant societies of North America show an optimum dispersal in moist climates subject to great temperature extremes. Relations of the bog societies are with the conifer rather than with the deciduous forests. The bog societies are considered as relicts of former widespread societies, and are observed in various places largely because of favorable temperature conditions. Edward W. Berry discusses 'Aralia in American Paleobotany,' giving a critical account of the fossil forms that have been referred to this genus.—In his concluding instalment of 'The Vegetation of the Bay of Fundy Salt and Diked Marshes: an Ecological Study,' Professor Ganong considers the mesophytic and hydrophytic conditions of the Bay of Fundy marshes, also the succession of plants in place and time. In his conclusion he makes an earnest appeal for more

careful description of ecological facts, longer periods of study before publication, and advance in the method of correlating meteorological data with vegetation, the recognition of physiological as well as structural adaptations, and a careful study of the exact nature of plant cooperation and competition.—Alice Eastwood publishes a synopsis of *Garrya*, a characteristic California genus, and describes three new species.—J. Y. Bergen, in a study of 'The Transpiration of *Spartina junceum* and other Xerophytic Shrubs,' has reached the conclusion that during the leafy season the relative power of transpiration of the leaves compared with that of the cortex is much greater for equal areas, and that leafless individuals of *Spartina* grow but little in any season.

SOCIETIES AND ACADEMIES.

THE SAN FRANCISCO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY.

THE fourth regular meeting of the San Francisco Section of the American Mathematical Society was held at the University of California on December 19, 1903. Fourteen members of the society were present. A number of other teachers of mathematics living in or near San Francisco attended both of the sessions. The following officers were elected for the ensuing year:

Chairman—Professor Allardice.

Secretary—Professor Miller.

Program Committee—Professors Haskell, Stringham and Miller.

The dates of the regular meetings of the section were changed from May and December to February and September. This change is to go into effect after the next regular meeting, which will be held at Stanford University in May. The following papers were read:

DR. E. M. BLAKE: 'Exhibition of models of polyhedra bounded by regular polygons.'

PROFESSOR M. W. HASKELL: 'Brianchon hexagons in space.'

PROFESSOR R. E. ALLARDICE: 'On the locus of the foci of a system of similar conics through three points.'

PROFESSOR IRVING STRINGHAM: 'On curvature in absolute space.'

PROFESSOR H. F. BLICHFELDT: 'On the order of linear homogeneous groups II.'

PROFESSOR E. J. WILCZYNSKI: 'Studies in the general theory of surfaces.'

PROFESSOR E. J. WILCZYNSKI: 'A fundamental theorem in the theory of ruled surfaces.'

PROFESSOR G. A. MILLER: 'On the roots of group operators.'

DR. D. N. LEHMER: 'On the Jacobian curve of three quadric surfaces and a certain ruled surface connected with it.'

DR. D. N. LEHMER: 'On a new method of finding factors of numbers.'

MR. W. A. MANNING: 'On the primitive groups of classes six and eight.'

PROFESSOR M. W. HASKELL: 'Approximations to the square root of positive numbers.'

In the absence of their authors, Dr. Blake's models were explained by Professor Haskell, Professor Wilczynski's papers were presented by Dr. Lehmer, and Mr. Manning's paper was read by the secretary.

G. A. MILLER,
Secretary.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 352d meeting was held December 15, 1903. The committee on the preservation of ancient monuments reported a form of petition to congress which might be sent out for signatures. The report was accepted, the committee continued and instructed to give publicity to the petition, and they were authorized to frame a bill on the lines of the petition.

Mr. W. H. Babcock communicated to the society a letter from Mr. J. E. Betts on the aborigines of China called Changkia and Miao.

The paper of the evening was by Dr. George Byron Gordon, of Philadelphia, on the subject, 'The Ruins of Copan.'

Doctor Gordon traced the limits of the Maya and Aztec peoples, and said that they sprung from a stem whose origin and location is wrapped in mystery. Views of the elaborately carved monoliths of Quirigua were thrown on the screen and Doctor Gordon said that those showing bas reliefs of men are placed to the north and those of women to the south of a given line through the ruins. No metals were found here and few stone tools, but the sculpture was worked out with stone implements. The phases of art displayed in

the monoliths were discussed and it was pointed out that the dragon-like carvings of serpents represent the rattlesnake, the spots on the back being transferred to the side in the carving. Views of the sculptures, the ruins and surroundings of Copan were next presented and discussed. One of the pyramids has been partly cut away by a stream, and in the section are a number of successive pavements and sewers, giving evidence of considerable antiquity to the structures.

Dr. H. M. Baum asked whether the present Mayas are descendants of the people who made the buildings. Doctor Gordon replied that none of the tribes know anything about them so far as any one has been able to discover.

Doctor Fewkes said that the Pueblo Indians call the north, male; the east, female; the south, male; and the west, female. The great plumed serpent of the Pueblo mythology is also related to the serpent of Central America. Doctor Fewkes believes that the different cities of Copan carry back man on this continent a long period.

Doctor Hrdlicka said, in reference to the buried cities of Copan exposed in the section of a pyramid, that the work may represent different periods of advancement of the structure rather than different ages.

At the close of the meeting a vote of thanks of the society was given to Doctor Gordon for his interesting paper.

WALTER HOUGH.

THE SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

A MEETING of the club was held on November 17, when two papers were presented by Professor Augustus Trowbridge, as follows:

(a) 'Personal Reminiscence in an Italian University.' This paper was illustrated with lantern slides and dealt with the lecturer's experiences while recently traveling in Italy. (b) 'New Experiments in Wireless Telegraphy,' was a description of some recent original devices got up by the lecturer for receiving wireless messages. The paper was illustrated, and wireless messages were received in the lecture room during the lecture.

VICTOR LENHER,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE LUNAR THEORY.

IN a recent number of the *Monthly Notices* of the Royal Astronomical Society, Mr. P. H. Cowell gives an account of his investigations on the motion of the moon. He finds considerable errors in Airy's theory, but gives no explanation of the small defect in the tables of Hansen. A curious result of several investigations is to show the accuracy of the tables of Damoiseau, made four score years ago, and after a theory which has gone out of use.

The interest now shown in the lunar theory by several astronomers promises to give us better tables of the moon. Two methods can be followed. The attractive one is to make a new theory, since in this case one has the entire question in hand. But this requires a great expenditure of labor. The other method would be to correct the tables of Hansen. The accuracy of the coefficients in these tables is very great, and it is a pity so much good work should be lost. In determining the orbit of the moon for the formation of his tables Hansen introduced twelve unknown quantities into his equations of condition, or fourteen, if we include the two depending on the distance from the center of figure to the center of gravity of the moon. It is not much wonder that a small error should have been committed in such a complicated theory. The manuscript of Hansen must be preserved, probably in the observatory of Gotha, where he spent most of his life. There are several astronomers in Germany who studied with Hansen, and who understand his methods. It is to be hoped that a careful revision of Hansen's calculations on this theory will be made and that his error may be discovered.

After looking at some of the works on this theory I venture to make this suggestion: that astronomers should unite on a system of notation for the lunar theory. So many changes have been made that it is almost necessary to have a dictionary of symbols in order to read the various memoirs.

A. HALL.

NORFOLK, CONN.,
January 5, 1904.

THE SCAURS ON THE RIVER ROUGE.

TO THE EDITOR OF SCIENCE: The earth's rotation causes in the winds of our hemisphere a tendency to deviate to the right of straight ahead in whatever direction they are flowing (Davis' 'Meteorology,' p. 101). It ought to produce the same effect on rivers (Russell, 'Rivers of North America,' p. 41). Instances have been supposed to be found in the streams on the south coast of Long Island (*American Journal of Science*, 1884, p. 427), in the great detrital cone of Lannemezan, on the Rhine, Danube, Ob, Irtish, Nile, New Zealand streams, Parana and Paraguay by authors cited in Penck, 'Morphologie der Erdoberfläche,' pp. 351-360. From objections that have been made to most of these illustrations it appears that there is more of unanimity as to the theory than in the conviction aroused by the evidence offered.

The Michigan rivers have long seemed to me suitable to examine for evidence of this sort. They are young, meandering streams, not usually encountering ledges, but flowing either in lake clays or in a till that has few large boulders and is fairly homogeneous.

The Rouge is a stream some twenty-five miles long that flows into the Detroit River a few miles west of Detroit. At Dearborn two forks of the river unite into one. Early in November I visited the west branch in company with Mr. Isaiah Bowman to look over the availability of the valley for work with my class in field geography. The river is ten or fifteen feet wide, meandering on a flood plain two or three hundred feet wide, which is incised in the level clays that once formed the floor of Lake Maumee. Every now and then the stream in its meandering undercuts the bank, causing a naked bluff of clay in a landscape that is elsewhere well grassed. Such a bluff is what the Scotch call a scaur. As the scaurs indicated the points where the river is actually at work widening its valley, it was proposed to measure the proportion of bank occupied by them. To this end we paced the distance along the river bank under each scaur and by the flood plain to the next one, noting whether the scaur was on the right bank or

the left. The results are given in the following table.

FIRST DAY.			
Right.	Scaur.	Left.	Flood Plain.
222			245
		55	187
		73	350
96			271
		90	442
73			303
		21	518
		34	273
41			287
76			236
50			280
		31	100
		53	466
95			168
<hr/>			
653		357	4,126
In all.....			5,136
Total both banks.....			10,272
Total scaur.....			1,010
Per cent. of scaur.....			10
Per cent. of scaur on right...			64

SECOND DAY.			
Right.	Scaur.	Left.	Flood Plain.
		66	295
56			300
		130	273
120			153
173			225
		195	1,160
		39	144
30			350
		60	245
16			341
178			256
		47	196
		37	100
200			343
48			260
100			1,218
27			78
30			30
		17	259
<hr/>			
978		591	6,406
Total			7,975
Total both banks.....			15,950
Total scaur.....			1,569
Per cent. of scaur.....			10
Per cent. of scaur on right..			62

Mr. Bowman's pacing gave practically the same results.

As my pace is 2.75 feet, we walked the first day 2.6 miles and the second 4.1, and found each time that along one tenth of its course the Rouge is widening its valley, while two thirds of this work is being done on the right bank. This called Mr. Bowman's attention

at once and he will prosecute further studies on this and other streams. Of course, the interest here is in a possible criterion for detecting deflection of rivers by the effect of the earth's rotation. The distance is short, yet the results are singularly uniform, as appears from the following analysis in detail.

Grouping the scaurs by successive amounts of about 500 paces, we have:

Total Scaur.	Right.	Left.	Percentage on Right.
536	318	218	59
474	335	139	71
545	349	196	64
518	224	294	43
506	405	101	80
<hr/>			
2,579	1,631	948	64

Rivers ought to show the effect of the earth's rotation and no criterion could be simpler in theory or application than this. As the Rouge flows fairly to the east prevalent westerly winds urge the river neither to right nor left.

MARK S. W. JEFFERSON.

MICHIGAN STATE NORMAL COLLEGE,
December 7, 1903.

SHORTER ARTICLES.

WONDER HORSES AND MENDELISM.

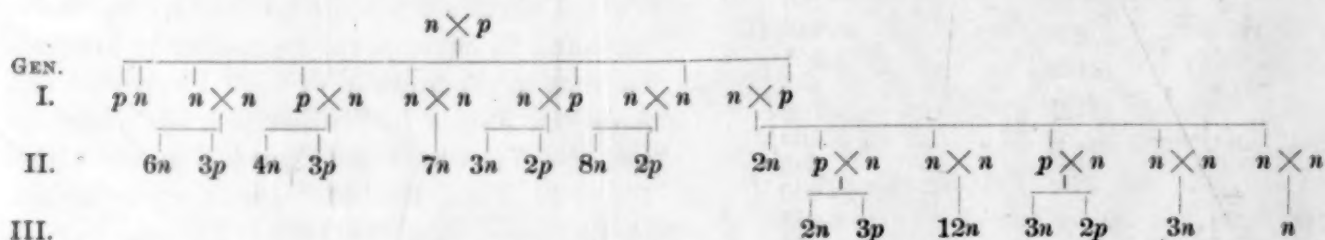
DR. CASTLE's reference to the Oregon Wonder horse in SCIENCE for December 11 reminds me that in the autumn of 1899 I corresponded with Mr. James K. Rutherford, of Waddington, N. Y., who then owned a horse called Linus II. Mr. Rutherford sent a photograph of the horse, taken in 1898. The photograph shows a Morgan horse probably about five years old with a double mane which trails on the ground on either side for a distance of two feet. The tail trails on the ground for a distance of about six to eight feet. Correspondence with Mr. Rutherford yielded the following additional statements: Linus II. is the son of Linus I., which had a mane that was single, but at fourteen years old eighteen feet long, while the tail was twenty-one feet long. "The mother also had a remarkable growth of hair." The paternal grandmother was known as the 'Oregon Beauty' and was noted for the mass and length of her hair. My correspondence with the owner of Linus I. led to few additional facts. He stated that the long

hair had been in the family since importation [to Oregon(?)] and added: 'the growth and quantity has increased with each generation.'

It will be seen that the data are somewhat inconclusive. Had the father as well as the mother of Linus I. been long-haired (recessive, according to Dr. Castle's hypothesis), then we can understand the long hair of Linus I. The latter was mated with a recessive (?) mare (if 'remarkable growth of hair' may be so interpreted) and produced Linus II.

On the whole, it would seem more probable that the long-haired property was dominant, unless, indeed, Linus II. got no long-haired progeny. The data are, as we see, insufficient to decide the matter.

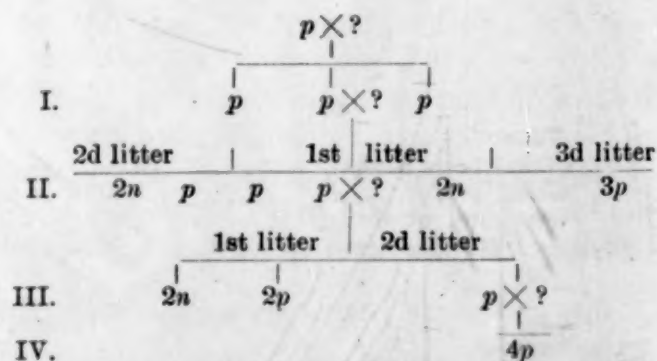
The question of the Mendelian behavior of animal mutations has long interested me and I have collected some statistics bearing on the subject. The records concerning polydactylism are, perhaps, the most complete and instructive. In the *Jenaische Zeitschrift*, XXII., Fackenheim, 1888, has given a table that may be thus summarized: Each letter n (normal) or p (polydactyl) stands for a person, the coefficient being used to indicate the number of such persons in a family.



On the assumption that polydactylism (p) is dominant and the normal condition (n) is recessive, any p of unknown ancestry may be a ($D + R$). Then the offspring of the parents $R \times (D + R)$ might give (DR) + (RR) or an equal proportion of p and n . There are 4 p and 4 n in the first filial generation; thus agreeing with theory. Of the p offspring of this first filial generation one third should be pure $D + D$ and should produce only polydactyl children even with normal consorts. This condition is not realized, for both of the polydactyls of whose offspring we have a record produced both n and p offspring; but this is not surprising, considering that there are

only two cases. The majority of the p offspring should produce p and n in equal numbers in the second filial generation—we get 7 p and 12 n in generation III. and 5 p and 5 n in generation IV. or 12 p and 17 n altogether, which is a wide but not unlikely disagreement from theory. Of the n children mated with n consorts, theory would demand that all should be n , since $R \times R$ gives only R qualities. In the second filial generation this happens in one family of seven children, but does not happen in two families with a total of 19 children in which 5 p 's occur. The total of the three families is 21 n and 5 p . This is not Mendelism, but there is certainly a marvelous prepotency of the normal quality. In the third filial question from three $n \times n$ families all of the 16 children are n . If we had this generation only we should certainly have a right to suspect that n is truly recessive.

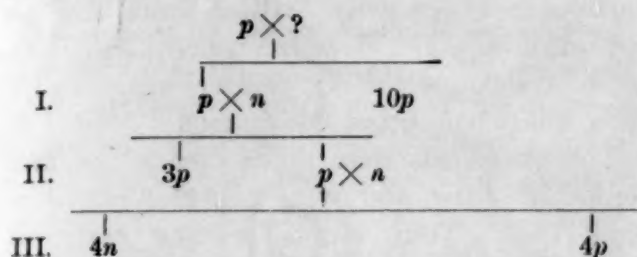
Consider next the records of polydactyl cats given by Poulton, 1883, in *Nature*. The fathers are not known, but Poulton says it is highly improbable that an abnormal female has ever crossed with a likewise abnormal male.



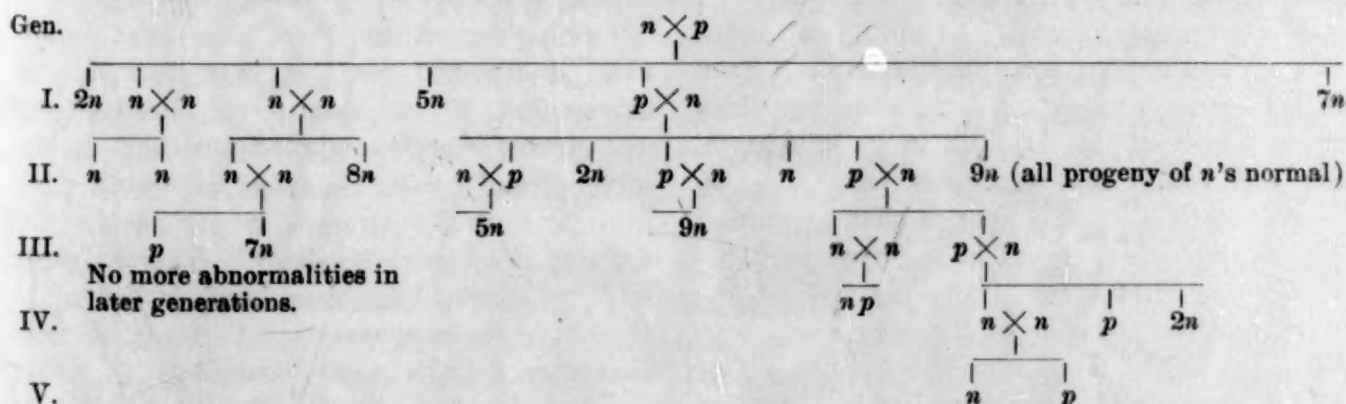
This case is easily explained on Mendelian principles, for assuming p to be dominant and the mother in the first filial generation to have ($D + R$) gametes, then there should be out of 10 offspring 5 p and 5 n ; there are 6 p and

4 n . The third generation accords with the assumption that the p parent has $(D+R)$ gametes, while the p parent in the third generation behaves as would one that had purely dominant gametes. Unfortunately, the record stops here.

Struthers has given the following case of polydactylism in man:



This result can be explained on the Mendelian hypothesis by considering the original parent to have only D gametes; and that the father was also polydactyl. The offspring (I.) are all p and purely dominant. In the first filial generation D is crossed with R and the dominant offspring have $(D+R)$ gametes; when one of these gametes of the second filial generation is crossed by R the product is $DR+RR$ (third generation). We should expect an equal number of dominant and recessive individuals and we get them. If, on the other hand, we calculate the proportion of abnormal individuals in accordance with Galton's Law we should get only 33 per cent. instead of the actual 50 per cent. Mendel's Law here accords with the facts better than Galton's Law.

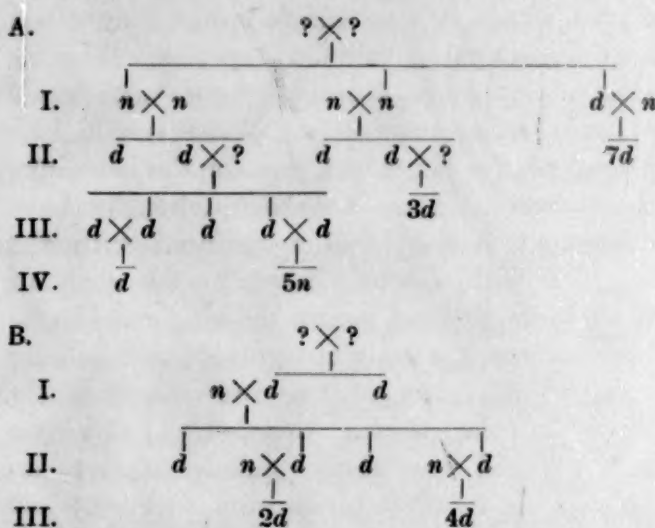


Another series is given by Struthers (1863) in the *Edinburgh New Philosophical Journal* for July. Mr. A. L., normal, married E. P., who had six fingers on the left hand. They had eighteen children, of whom one only was abnormal, with six fingers on both hands.

These relations and the remaining descendants are given in the accompanying diagram.

This case differs from the preceding in the small proportion of p 's occurring in any generation. These small percentages can hardly accord with Mendel's Law.

Finally, we may consider some cases of inheritance of deaf-mutism for records of which we are indebted to Bell, 1884, *Mem. National Academy of Sciences*, II., pp. 179 and 208.



It seems impossible to regard either n or d as recessive. If n is recessive how can d be derived from two n parents as in Case A, Gen. I.? If d is recessive, how can 5 n come from two d parents as in A, Gen. III.?

The conclusion of this communication is that while Mendelian principles seem applicable to

some cases of crosses between sports and the normal species, there seem to be others where neither Mendel's nor Galton's Law of Inheritance holds.

C. B. DAVENPORT.

HULL ZOOLOGICAL LABORATORY,
UNIVERSITY OF CHICAGO.

THE INHERITANCE OF SONG IN PASSERINE BIRDS.
REMARKS AND OBSERVATIONS ON THE SONG
OF HAND-REARED BOBOLINKS AND RED-
WINGED BLACKBIRDS (*DOLICHONYX*
ORYZIVORUS AND *AGELAIUS*
PHENICEUS).

DURING the past spring (1903) I secured a brood of bobolinks and two broods of red-winged blackbirds. These young nestlings were carefully reared, and, while allowed to hear many other kinds of birds sing, were not placed where it was believed that they could hear the songs of their own species. The results about to be described have been based on continuous observation, in the case of the blackbirds for six weeks, and for the bobolinks three weeks. Care has been taken to have competent judges, well acquainted with the song of both species, listen to the song of these birds without seeing the singers. In no instance was the song recognized; one listener ascribed the song of two red-winged blackbirds to the brown thrasher (*Toxostoma rufum*), and was wholly unable to form an opinion as to what birds were singing when listening to the performance of two bobolinks. It should be stated that there were but two males of each of the species in question from the broods that had been reared.

The song of the bobolinks is loud and brilliant as well as sustained; that of the red-winged blackbirds is even of greater volume and may be best described as continuous.

A word seems essential as to the call-notes of the two kinds of birds in question. I have failed to distinguish anything that resembles the call-note of the bobolink in its wild state, nor any sound that emanates from the two representatives of this species that are under observation which could be referred to bobolinks in a wild state. The interval of the notes and the duration of the song seem, however, not unlike those of wild bobolinks. One of the young birds, moreover, has been noticed both by myself and other observers attempting with a marked degree of success to sing the continuous rolling warble with its rising and falling inflection that characterizes the Hartz Mountain roller canary.

The call-note of the red-wing blackbird is

clearly distinguishable in the two red-wing blackbirds under observation, but is the only sound that might be referred to that species. The song of these two birds seems to be made up of a composite jumble wherein robin and thrush-like notes of great clearness and volume predominate. The duration of the song is not marked by any particular break, the performance generally lasting from five to ten minutes. The clear robin and thrush-like notes are connected by fainter warbles and lisps, the whole being continuous.

The blackbirds were taken during the first weeks in June and were probably about a week old. They began to sing early in September, and the only interruption was an interval of four or five days when they changed from the liberty of a room where they could fly about to two large room cages.

The bobolinks were taken on the twelfth day of June and were much younger than the blackbirds, being not more than four days old. They have been kept all the time together in a large cage, and have not known the freedom of a flying room. They began to sing about the first of November, and in a few days could be heard in song at almost any time during daylight.

WILLIAM E. D. SCOTT.

PRINCETON, N. J.,
November 30, 1903.

THE U. S. NAVAL OBSERVATORY.*

THE astronomical force has been gradually diminished year by year, first by the detachment of a number of line officers who were formerly assigned positions as observers, and more recently by the detachment of several professors of mathematics for duty at the Naval Academy. This not only left the observatory short-handed, but made frequent rearrangements of the personnel necessary. Each new assignment to astronomical duty retards the work, breaks up its continuity, and diminishes the output. It is such changes as these among subordinate officers who have special work to do that pro-

* From the reports of the Superintendent Rear-Admiral C. M. Chester, for the year ending June 30, 1903.

duce confusion, as in the case of every other executive branch of the government; not, as is frequently maintained, the change of the head or administrative officer. He must necessarily continue the policy left by his predecessor until experience has demonstrated the wisdom of innovations.

* * *

In addition to the drawback to efficient administration and labor caused by the reorganization of the personnel, most of the time of the superintendent and staff during the latter half of the year has been given up to answering questions called forth by several investigating boards. These boards have consisted of:

1. A board ordered by the Navy Department, composed of Rear-Admiral F. M. Ramsay, U. S. Navy; Capt. J. E. Pillsbury, U. S. Navy; and Commander C. J. Badger, U. S. Navy; 'for the purpose of inquiring into and reporting upon the advisability of eliminating or transferring to other than the control of the Navy Department any of the work now performed at the Naval Observatory.'

This board reported that 'in the opinion of the board, the regular work of the Naval Observatory is essential to the Navy; it can be systematically and successfully accomplished only under government control; and no portion of it should be discontinued or transferred to other than the control of the Navy Department.'

2. The General Board of the Navy, of which Admiral of the Navy George Dewey is president, to which was referred the same subject that was referred to the preceding board, rendered a similar decision.

3. A committee ordered by the President of the United States, composed of Mr. Charles D. Walcott, chairman; Brig. Gen. William Crozier, U. S. Army; Rear-Admiral Francis T. Bowles, U. S. Navy; Mr. Gifford Pinchot and Mr. James R. Garfield, to report upon various matters connected with the organization of the government scientific work. The report of this committee has not yet been made public, but it also thoroughly investigated the Naval Observatory.

Added to the drain on the time of the astronomical staff incident to the above-enumerated conditions is that due to the greatly increased demand for navigational instruments for the numerous ships building for the Navy. No small portion of the labor due to this demand has fallen on the Naval Observatory. Formerly from four to six naval line officers were employed in the three departments of nautical instruments, storekeeper and chronometers and time service. Now one lieutenant-commander is the only line officer detailed for the combined duties of all three departments. Other branches of the naval service have been supplied with additional men paid from the general appropriation 'Increase of the Navy' to meet these conditions, but the requirements of this observatory seem to have been overlooked.

Failing to procure the needed force for this important service, it has been necessary, under the Bureau of Equipment's general order to sacrifice astronomy for military duties, to assign two computers from the astronomical force to keep up with the extraordinary demands of the fleet. Further than this, as is shown in the report of the head of the department of nautical instruments, articles of equipment for naval vessels are such that the board of inspection which passes upon invoices before they are paid for must devote much time to the examination of each article, and thus not only has the fleet made an unusual number of calls on the observatory staff, but each call has required a greater amount of time than is usual at other naval stations. It should be remembered that navigational instruments can not be passed over with the cursory inspection given to ordinary supplies for a ship, but must be subjected to a critical test of all their different parts under varying conditions, needing at times several hours to pass one item of a schedule. As the one line officer at the observatory can not report upon the articles under his charge, professors of mathematics who are employed for astronomical work have been detailed to act on the board of inspection, thereby detracting from their own individual work.

Feeling as I do that the work of the Naval

Observatory has been greatly handicapped by the conditions briefly outlined above, I commend to the department the zeal of the staff as worthy of more consideration than seems to have been accorded it in the past. The members of the staff have vied with each other during the past year in doing more than was required of them, and thus have been enabled to maintain a good average of records; but such conditions can not be expected to continue. In one instance a member of the Nautical Almanac Department, Mr. H. B. Evans, in addition to a full-time service in that department, has devoted a good part of three nights in the week to observational astronomy, giving to the records data of much value. Also, Mr. Hammond, a member of the computing division of the observatory, has contributed overtime work in the search for and location of asteroids, a work that has been much appreciated by outside astronomers.

Such observations have been published in astronomical periodicals and the authors given credit for their work, thus making an incentive for additional labor.

While such work may be only incidental to naval purposes, it helps to maintain the interest of observers in a class of astronomy that is more or less a drudgery and carries out the precept of the observatory to contribute to astronomical science. It also produces better results in routine observations.

SCIENTIFIC NOTES AND NEWS.

THE French minister of public instruction and fine arts has conferred the degree of officer of public instruction upon Dr. Lester F. Ward for his scientific and sociological works. This highest degree of the academic order is usually only conferred on persons who have for five years held the degree of officer of the academy.

DR. W. ROUX, professor of anatomy at Halle, has been elected a foreign member of the Brussels Academy of Sciences.

PROFESSOR H. DE VRIES, of Amsterdam, and Professor R. von Wettstein, of Vienna, have been elected honorary members of the Berlin Botanical Society.

GRANTS in aid of research have recently been made from the Rumford Fund of the American Academy of Arts and Sciences as follows: to Professor Edward W. Morley, for his research on the nature and effects of ether drift, \$500; to Professor Carl Barus, for his research on the study by an optical method of radio-actively produced condensation, \$200; to Mr. J. A. Dunne, for his research on fluctuations in solar activity as evinced by changes in the difference between maximum and minimum temperature, \$200.

PRESIDENT ROOSEVELT has appointed the assay commission for 1904, which will test the weight and fineness of coins produced at the mints of the United States during the year. The members include Dr. S. W. Stratton, chief of the Bureau of Standards; Mr. Marcus Benjamin, of the Smithsonian Institution; Professor Edgar F. Smith, of the University of Pennsylvania, and Professor William Hallock, of Columbia University.

MR. J. A. EWING, F.R.S., lately professor of mechanism and applied mechanics, Cambridge, and Mr. Karl Pearson, F.R.S., professor of applied mathematics in University College, London, and formerly fellow, have been elected to honorary fellowships at King's College, Cambridge.

THE silver medal of the Munich Academy of Sciences has been conferred on Professor Rudel, of Nuremberg, for his researches in climatology.

DR. W. T. BLANFORD, F.R.S., who was on the staff of the Geological Survey of India from 1855 to 1872, has been made a Companion of the Order of the Indian Empire.

MR. R. G. CARRUTHERS and Mr. G. W. Graham have been appointed geologists on the British Geological Survey.

BRIGADIER-GENERAL A. W. GREELY, chief signal officer of the U. S. Army, has refused to go on the retired list with the rank of major-general, preferring to remain in active service.

DR. T. D. WOOD, professor of physical education in Teachers College, Columbia University, has been given leave of absence for the rest of the year on account of his health.

PROFESSOR E. B. VOORHEES, of Rutgers College, has been appointed president of the New Jersey State Board of Agriculture.

MR. OTTO E. JENNINGS has been appointed custodian of botanical collections at the Carnegie Museum, Pittsburg, Pa. Mr. Jennings has been Professor Kellerman's herbarium assistant for two years in the Ohio State University.

DR. E. W. OLIVE, who has been studying for the past year some nuclear problems of certain lower plants in the laboratory of Professor Strasburger, has received another grant from the Carnegie Institution and will continue his work in the laboratory of Professor Harper, at Madison.

PROFESSOR VERNON F. MARSTERS, of the department of geology in the University of Indiana, is spending a year's leave of absence at Columbia University, pursuing work in geology and anthropology.

MR. GEORGE T. HASTINGS, a graduate of Cornell University and assistant in botany in that university in 1899-'00, recently returned from Santiago, Chili, where for two years he has been teacher of science in the English Institute. Mr. Hastings made a good collection of plants from central Chili during his stay there and is now preparing sets for distribution to herbaria. He is doing this work in the botanical department at Cornell.

PROFESSOR BLANCHARD, of Paris, accompanied by Dr. R. Wurtz, professor in the medical faculty of the University of Paris, and twelve students of the Paris Institut de Médecine Coloniale, paid a visit to the London School of Tropical Medicine on December 28.

As we have already stated, Dr. Hans Gadow, F.R.S., lecturer on zoology in the University of Cambridge, is coming to America at the end of March for the purpose of giving six lectures on 'The Coloration of Amphibia and Reptiles,' specially prepared for the Lowell Institute in Boston. He desires to secure engagements for lectures in other institutions. Communications regarding engagements for lectures may be sent directly to Dr. Gadow at the University Museum of Zoology, in Cambridge, or, after March 15, in care of Pro-

fessor W. T. Sedgwick, Massachusetts Institute of Technology, Boston.

It is expected that Dr. Alexander Graham Bell, bringing the remains of James Smithson on the steamship *Princess Irene*, will arrive in New York this week. It is planned that the *Dolphin*, of the U. S. Navy, will meet the steamship and carry the remains of Smithson to Washington.

THE District of Columbia Library Association has held a meeting in memory of the late Henry Carrington Bolton and Marcus Baker. Professor F. W. Clarke made the principal address on Dr. Bolton, and Dr. W. H. Dall, the principal address on Mr. Baker.

THE Max Müller Memorial Fund, which is to be held in trust by the University of Oxford for the promotion of learning and research in the history, archeology, languages, literature and religion of ancient India, now amounts to about \$12,000.

It is proposed to erect at Rome a memorial to the eminent mathematician, Luigi Cremona, and it is hoped that the contributions will be international in character. Subscriptions should be sent to Signor I. Sonzogno, Piazza San Pietro in Vincoli, 5, Rome.

THE death is announced of Miss Anna Winlock, of the Harvard College Observatory. She was the daughter of Professor Joseph Winlock, superintendent of the Nautical Almanac, and later, until his death in 1875, director of the Harvard College Observatory. At this time Miss Winlock entered the observatory as a computer and subsequently assisted in the preparation of a large number of important papers issued from the observatory.

THE death is announced of the eminent professor of psychiatry and nervous diseases in the University of Berlin, Dr. Friedrich Jolly. Professor Jolly, who was born at Heidelberg in 1844, occupied professorial chairs at Würzburg and at Strasburg before he was called to Berlin in 1890. We regret also to record the deaths of M. Jean Dufour, professor of plant physiology at Lausanne at the age of forty-three years; of Dr. A. Edmund Hess, professor of mathematics at Marburg, at the age of sixty years; of Dr. Sophus Ruger, professor

of geography and anthropology at the Technical Institute of Dresden, at the age of seventy-two years, and of Dr. Sophie Perejaslawzena, formerly head of the Zoological Station at Sebastopol.

A CABLEGRAM to the New York *Times* states that by the will of the late Herbert Spencer all rights and property in his books and investments are given to the trustees, the Hon. Auberon Herbert, Dr. Henry Charlton Bastian and David Duncan, with instructions to employ the yearly revenue "in resuming and continuing during such period as may be needed for fulfilling my express wishes, but not exceeding the lifetime of all descendants of Queen Victoria who shall be living at my decease and of the survivors and survivor of them, and for twenty-one years after the death of such survivor, the publication of the existing parts of my 'Descriptive Sociology,' and the compilation and publication of the fresh parts thereof upon the plan followed in the parts already published." Afterward all copyrights, stereotype plates, etc., are to be auctioned and the proceeds divided among a number of scientific societies. The will orders that Spencer's autobiography is to be published simultaneously in Great Britain and the United States, and requests David Duncan to write a biography in one volume of moderate size.

THE Linnean Society of New South Wales has received about \$170,000 from the late Sir William Macleay for the endowment of research fellowships in science.

WE learn from *Nature* that a meeting was held in the house of the Zoological Society on January 5 to consider proposals for the organization of zoologists. Forty-one zoologists from England, Scotland and Ireland attended the meeting. The following resolution was carried by a large majority: "That it is desirable that the zoologists of Great Britain and Ireland be organized for the consideration of all matters affecting the interests of zoology and zoologists, and to take such action as may seem desirable." A committee consisting of Professor Cossar Ewart, Professor Bridge, Professor Hickson, Dr. Scharff,

Dr. G. C. Bourne, Dr. Ridewood and Mr. Cunningham was appointed to draw up a scheme.

BARON ERLAND NORDENSKJÖLD's expedition to Peru and Bolivia is expected to arrive about February 15 at La Paz, the capital of Bolivia, which will be the departing point for the expedition to Lake Titicaca.

OWING to a fire in a printing house in New York City the electrotypes and matter in type of several volumes of the *Transactions* of the American Institute of Electrical Engineers have been destroyed.

Nature states that the Brothers Kearton have arranged to hold an exhibition of enlarged photographs of birds, beasts, reptiles and insects at the Modern Gallery, London, on January 2-12, 1904, inclusive. The gallery will be open from 10 A.M. until 9 P.M., and Mr. R. Kearton will deliver lime-light lectures to children each afternoon, and to adults in the evening.

WE learn from the London *Times* that Mr. James G. Ferrier, secretary of the Scottish Antarctic Expedition, has received from Mr. W. S. Bruce, the leader of the expedition, narratives of the voyage of the *Scotia*, written by Mr. Bruce and the individual members of the staff, dealing with meteorology, zoology, biology and other scientific departments of the work of the expedition. Mr. Bruce, in his letter, stated that the *Scotia* had made a very satisfactory record, and he expressed the hope that he and his staff might be allowed to complete their researches. The appeal for funds to enable the expedition to prolong its stay in the Antarctic has now been so liberally responded to that the cruise will be continued for at least six months, and as Mr. Ferrier is still receiving donations an extension for a year may be possible. Mr. Bruce's desire will then be fulfilled. Meantime, the *Scotia* has gone north to Buenos Ayres to refit. The expedition left its winter quarters in Scotia Bay, South Orkney Islands, on November 23—sooner than was anticipated owing to the unexpected breaking of the ice. Some members of the expedition were left behind in the winter quarters in charge of a meteorolog-

ical station. They were stocked with provisions for fully 18 months, and the place also abounds with penguins, fish and seals. Mr. Bruce reports that all on board the *Scotia* are in robust health and eager for further work.

DR. H. W. WILEY, chief of the Bureau of Chemistry, U. S. Department of Agriculture, appeared before the committee on commerce of the house of representatives on January 5, in support of the pure food bill now before congress.

THE regular annual meeting of the New Mexico Academy of Sciences, held on December 28, at Santa Fé, was well attended and interesting papers were presented. The geological part of the program included the following: Presidential address by Hon. Frank Springer on the 'Life of Louis Agassiz'; 'Note on Block Mountains,' by Dr. Charles R. Keyes; 'New Rapid Assay Method for Zinc,' by Professor Francis C. Lincoln; 'Glaciation in the High Plateau of Bolivia,' by Professor W. G. Tight; 'Revised Geological Column for New Mexico,' by Dr. Charles R. Keyes; 'Notes on Some New Mexico Minerals,' by Dr. Rufus M. Bagg; 'Some Irrigation Problems in New Mexico,' by Professor Oliver R. Smith; 'Geographic Development of South America,' by Professor W. G. Tight. The president of the academy is Hon. Frank Springer, of Las Vegas; vice-president, Dr. Charles R. Keyes, president of the New Mexico School of Mines, Socorro; secretary, Professor W. G. Tight, of Albuquerque.

At a recent meeting of the State Commission in Lunacy, held December 1, the recommendation contained in the resolution passed by the advisory board of the Pathological Institute, October 29, 1903, to the effect that: "Physicians appointed to the state hospital service should serve a preliminary term of from three to six months on Ward's Island; that the Pathological Institute and the Manhattan State Hospitals on Ward's Island organize a training school for this purpose and that provisions be made for the construction of additional accommodations in connection with the staff house at Manhattan State Hos-

pital, west," was given careful consideration. The recommendation was adopted, and the state architect has already been notified to arrange at once plans and specifications for the construction of an addition to the staff house at Manhattan, west, to the extent of providing twelve additional bed-rooms.

At a meeting of the British Astronomical Association, held on December 30, Sir William Ramsay gave a lecture entitled 'Some Speculations regarding Atoms and Stars.' Beginning with a sketch of the discovery of helium, he gave reasons for holding that terrestrial helium was the same as that existing in the sun, and that there was no other unknown body, asterium, associated with it in the chromosphere, as was sometimes supposed. He next pointed out that of the group of inactive gases, helium, neon, argon, krypton and xenon, only helium and krypton had been detected in stellar bodies, and went on to apply the fact that the characteristic line of krypton was prominent in the spectrum of the aurora to the explanation of that phenomenon. These five gases, having their molecules composed of single atoms, not of a pair of atoms like the other gases of the atmosphere, would get heated more rapidly than the others, and would be carried up more rapidly to the outer confines of the atmosphere by the general atmospheric circulation. Hence the top layers of the atmosphere might be supposed to consist largely of those gases. Now, Arrhenius's hypothesis was that electrified particles were shot out from the sun and in turn electrified the gases in those top layers; in this way the argon and its companions would be excited to yield their characteristic spectra. The reason why that of krypton alone was visible was, as was indicated by laboratory experiments he had carried out, because it had a greater power of emitting light than the others. The aurora might then be considered as a ring discharge round the poles of the earth, by which the yellow-green line of krypton, the line that made the aurora what it was, was caused to shine out, the streamers being the effect of the magnetic action exerted by the earth. In the latter part of his lecture, Sir William Ramsay described some of the phenomena af-

forded by radium. He described how, in addition to three kinds of rays, it gave off a self-luminous gas or emanation, which contracted very quickly—so quickly indeed that in a month it contracted itself out of existence, leaving only a purple discoloration in the glass of its tube. He told how in trying to get the spectrum of this emanation he found one of the helium lines, and a few days later discovered that the tube yielded the complete spectrum of helium, his inference being that the emanation was continually changing into helium which perhaps disappeared in the glass. The speculation was suggested that there was a limit to the size of atoms, as of stars, and that some atoms were too heavy to be stable and threw off electrons, just as the planets, on the nebular hypothesis, were thrown off by the original nebula. The atoms of bodies like uranium or radium might be supposed to have reached this limit of stability, and conceivably the electrons they shot off formed matter with simple atoms which in turn polymerized into heavier ones.

UNIVERSITY AND EDUCATIONAL NEWS.

SYRACUSE UNIVERSITY has received \$150,000 from the estate of the late James J. Belden. \$50,000 goes to the Medical College and \$100,000 to the College of Liberal Arts. Syracuse University also receives the residue of the estate of the late John Lyman. The value of the estate is not stated; but special bequests to charitable institutions were made by Mr. Lyman, amounting to over \$150,000.

THE new library building of Clark University was dedicated on January 14. The building has been erected at a cost of \$125,000 provided by the will of the founder of the university. President Hall announced a gift of \$100,000 from Mr. Andrew Carnegie for the library, this gift being made in honor of Senator Hoar, president of the board of trustees.

THE Catholic University of America has received \$50,000 from the Knights of Columbus for the endowment of a chair of secular history.

PRINCETON UNIVERSITY has received a bequest of \$25,000 from the late Louis C. Vanuxem, of Philadelphia.

E. W. D. HOLWAY, banker of Decorah, Iowa, has given his private library and collection of fungi to the University of Minnesota. The library numbers about 1,000 volumes, including many rare and valuable works, and the collection, with some 85,000 specimens, is especially rich in illustrative material of the smuts and rusts, a group in which Mr. Holway is a well-known specialist.

SIR WILLIAM H. WILLS and Sir Frederick Wills have each contributed \$5,000 to liquidate the debt of \$25,000 at University College, Bristol. The whole sum has now been collected.

THE Rev. Dr. William E. Huntington has been elected president of Boston University. He has been since 1882 dean of the university, and since the resignation of Dr. Warren last year, acting president. The trustees decided that the university should equip laboratories for chemistry, physiology, biology, geology and botany, but that the courses in physics be continued as heretofore at Massachusetts Institute of Technology.

J. H. BAIR, PH.D., Carnegie research assistant working in the psychological laboratory of Columbia University, has been appointed professor of psychology and education in the University of Colorado.

At Edinburgh University, Mr. E. M. Horsburgh has been appointed lecturer on practical mathematics; Dr. Jacob Halm, lecturer on astronomy, and Dr. H. J. Stiles, lecturer in applied anatomy.

MR. HERBERT TOMLINSON, F.R.S., known for his contribution to physics, has resigned the principalship of the Southwestern Polytechnic at Chelsea, London.

MR. R. H. YAPP, of Cambridge, has been appointed professor of botany in the University College of Aberystwyth.

PROFESSOR F. C. M. STÖRMER has been appointed professor of pure mathematics at the University of Christiania.